

**Economic Research Initiative on the Uninsured  
Working Paper Series**

**AN EQUILIBRIUM MODEL OF HEALTH INSURANCE  
PROVISION AND WAGE DETERMINATION**

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ERIU Working Paper 19  
<http://www.umich.edu/~eriu/pdf/wp19.pdf>

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December 2003

This research was partially supported by grants from the Economic Research Initiative on the Uninsured at the University of Michigan and the C.V. Starr Center for Applied Economics at New York University. We are grateful for comments received from participants in the “Econometrics of Strategy and Decision Making” conference held at the Cowles Foundation in May 2000, the annual meeting of the European Society for Population Economics held in Bonn in June 2000, the meetings of the Canadian Econometric Study Group held in October 2002, and seminar participants at Chicago, McGill, Ohio State, UCSD, Pompeu Fabra, CREST, UCLA, Georgetown, and Wisconsin. We have also received many valuable comments from Jaap Abbring, Jeffrey Campbell, Donna Gilleskie, Vijay Krishna, Jean-Marc Robin, and three anonymous referees. The views expressed here are ours and do not necessarily represent the views of the U.S. Department of Labor or the Bureau of Labor Statistics. We are responsible for all errors, omissions, and interpretations.

## **Abstract**

We investigate the effect of employer-provided health insurance on job mobility rates and economic welfare using a search, matching, and bargaining framework. In our model, health insurance coverage decisions are made in a cooperative manner that recognizes the productivity effects of health insurance as well as its nonpecuniary value to the employee. The resulting equilibrium is one in which not all employment matches are covered by health insurance, wages at jobs providing health insurance are larger (in a stochastic sense) than those at jobs without health insurance, and workers at jobs with health insurance are less likely to leave those jobs, even after conditioning on the wage rate. We show that for inefficient mobility decisions to occur in our framework requires that firms be heterogeneous with respect to their costs of providing health insurance. We estimate the primitive parameters of the model using data from the SIPP 1996 panel and find that the empirical implications of the estimated model are in accord with both the data and anecdotal evidence. Heterogeneity in the distribution of firm costs of health insurance does lead to some inefficient (in the short-run) mobility decisions, but the vast majority of moves from job to job are associated with productivity improvements.

# 1 Introduction

Health insurance is most often received through one's employer in the United States. According to U.S. Census Bureau statistics, almost 85 percent of Americans with private health insurance obtain their coverage in this manner. This strong connection between employment decisions and health insurance coverage has resulted in a substantial amount of research exploring the possible explanations for and impacts of this linkage. One branch of the literature has investigated the relationship between employer-provided health insurance and job mobility. In spite of a substantial amount of research on the issue, the relationship between health insurance coverage and mobility rates has not as yet been satisfactorily explained. Basing their arguments largely on anecdotal evidence, many proponents of health care reform claim that the present employment-based system causes some workers to remain in jobs they would "rather" leave since they are "locked in" to their source of health insurance. While it is true that individuals with employer-provided health insurance are less likely to change jobs than others (Mitchell, 1982; Cooper and Manheit, 1993), the claim that health insurance is the cause of this result has not been established. Madrian (1994) estimates that health insurance leads to a 25 percent reduction in worker mobility, while Holtz-Eakin (1994) finds no effect, even though they use an identical empirical methodology. Building on their approach, Buchmueller and Valletta (1996) and Anderson (1997) arrive at an estimate of the negative impact of health insurance on worker mobility that is slightly larger (in absolute value) than Madrian's, while Kapur (1998) concludes there is no impact of health insurance on mobility. The most recent and only paper in this literature that attempts to explicitly model worker decisions, Gilleskie and Lutz (2002), finds that employment-based health insurance leads to no reduction in mobility for married males and a relatively small (10 percent) reduction in mobility for single males. Using statewide variation in continuation of coverage mandates, Gruber and Madrian (1994) find that an additional year of coverage significantly increases mobility, which they claim establishes that health insurance does indeed cause reductions in mobility. While this literature has extensively examined how the employment-based health insurance system affects mobility, the more pressing welfare implications have largely been ignored (Gruber and Madrian (1997) and Gruber and Hanratty (1995) are notable exceptions).

If health insurance coverage is strictly a nonpecuniary part of the compensation package offered by an employer, like a corner office or reserved parking space, the theory of compensating differentials would predict a negative relationship between the cost (or provision) of health insurance and wages conditional on the value of the employment match. Somewhat surprisingly (from this perspective), Monheit et al. (1985) estimate a positive relationship between the two. Subsequent research has attempted to exploit potentially exogenous variation from a variety of sources in order to accurately identify the "effect" of health insurance on wages. Gruber (1994) uses statewide variation in mandated maternity benefits, Gruber and Krueger (1990) employ industry and state variation in the cost of worker's compensation insurance, and Eberts and Stone (1985) rely on school district variation in health insurance costs to estimate the manner in which wages are affected. All three conclude that most (more than 80 percent) of the cost of the benefit is reflected in lower wages. In addition, Miller (1995) estimates significant wage decreases for individuals moving from a job without insurance to a job with insurance. Hence, the research that examines to what extent health insurance costs are passed on to employees finds that a majority of the costs are borne by employees in the form of lower wages.

These results from the two branches of the literature seem inconsistent on the face of it. If individuals are bearing the cost of the health insurance being provided to them by their employer, why are they apparently less likely to leave these jobs? In addition, the absence of a conceptual framework that is consistent with many of the empirical findings on "job lock" and the indirect

costs of health insurance to workers means that few policy implications can be drawn from the empirical results that have been obtained.

In this paper we attempt to provide such a framework by developing and estimating an equilibrium model of employer-provided health insurance and wage determination. The model is based on a continuous-time stationary search model in which unemployed and employed agents stochastically uncover employment opportunities characterized in terms of idiosyncratic match values. Firms and searchers then engage in Nash bargaining to divide the surpluses from each potential employment match. In contrast to traditional matching-bargaining models (e.g., Flinn and Heckman, 1982; Diamond, 1982; and Pissarides, 1985), we allow employee “compensation” to vary over both wages and health insurance coverage. In our framework, health insurance has two potential welfare impacts on the worker-firm pair. First, by inducing the employee to utilize health care services more frequently it increases his productivity in the sense of reducing the frequency of negative health outcomes that lead to the termination of the match. Due to search frictions, the preservation of an acceptable match provides a benefit to both the employer and the employee. Second, at least some individuals may exhibit a “private” demand for health insurance. We view this demand as mainly arising from the existence of uncovered dependents in the employee’s household.

The main novelty in our modeling framework is our view of health insurance as a productive factor in an employment match, in addition to any direct utility-augmenting effects it may have. As a result, the level of health insurance coverage is optimally chosen given the value of the productivity match and idiosyncratic characteristics of the worker and firm. The productivity-enhancing nature of health insurance is modeled as follows. Since an employment contract may terminate due to the poor health of the employee, we view health insurance coverage as reducing the rate of “exogenous” terminations from this source. There is some support for our assumption in the empirical literature. Levy and Meltzer (2001) provide a very thorough survey of empirical research examining the relationship between health insurance coverage and health outcomes. With special reference to results from large-scale quasi-experimental studies and the Rand randomized experiment, the authors conclude that there exists solid evidence to “suggest that policies to expand insurance can also promote health.” Since we find overwhelming support for our assumption in the course of estimating the model,<sup>1</sup> our results could be taken as adding further (albeit indirect) support to the proposition that health insurance improves health.

Beginning from this premise, we are able to derive a number of implications from the model that coincide with both anecdotal and empirical evidence. Most basically, the model implies that: (1) not all jobs will provide health insurance, (2) workers “pay” for health insurance in the form of lower wages, and (3) jobs with health insurance coverage tend to last longer than those without (both unconditionally and conditionally on wage rates).

In order to explicitly investigate the “job lock” phenomenon, it is necessary for us to allow for on-the-job search with resulting job-to-job transitions. This necessitates that we model the process of negotiation between a worker and two potential employers which we are able to accomplish after making some stringent assumptions regarding the information sets of the agents involved in the bargaining game. This is the first attempt to estimate such a model in a Nash bargaining context, though using French worker-firm matched data Postel-Vinay and Robin (2000) estimate an equilibrium assignment model that includes renegotiation.<sup>2</sup> They assume that firms appropriate all of the rents from the match, which is a limiting case of the Nash bargaining model we employ.

Estimates of the primitive parameters characterizing the model using data from the 1996 panel

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<sup>1</sup>We do not impose the theoretical restriction when the model is estimated, yet find that the estimated rate of “involuntary” job separations for the uninsured is an order of magnitude greater than the rate for the insured.

<sup>2</sup>The recent paper by Cahuc et (2003) uses a similar bargaining structure to the one employed in this paper, though that paper provides a much deeper analysis of the bargaining game played by potential employers and workers.

of the Survey of Income and Program Participation (SIPP) tend to support our model specification. In particular, we find that the rate of “involuntary” separations from jobs without health insurance is about 8 times greater than at jobs with health insurance. We find broad conformity with the implications of the model on a number of other dimensions as well. The raw data suggest that jobs providing health insurance are substantially longer than those that do not provide it, though due to substantial amounts of right-censoring of spell lengths the precise magnitude of the difference is difficult to determine. Model estimates imply that the ratio is on the order of 6. The model also does a reasonably good job of fitting the observed conditional wage distributions (by health insurance status) and the unconditional distribution of wages.

We are also able to look at the claim that nonuniversally-provided health insurance leads to inefficient mobility decisions. We demonstrate that within our model all mobility decisions are efficient in a generalized sense. We allow for heterogeneity in the population of firms with respect to the cost of providing and health insurance and within the population of searchers with respect to the “private” valuation of health insurance. While time-invariant searcher heterogeneity cannot lead to inefficient turnover decisions, time invariant firm heterogeneity can, at least in one specific sense. A worker who faces the choice between two firms at a point in time with two known match values  $\theta$  and  $\theta'$  may choose to work at the lower match value firm if that firm offers lower costs of health insurance than does the other. While the match chosen will always be the one providing higher total surplus to the worker-firm pair, the fact that a lower match value is chosen may be taken to represent a form of inefficiency - at least in comparison with a world in which all potential matches face the same cost of providing coverage. Given our estimates of the health insurance cost distribution within the population of employers, even this limited form of “inefficiency” is found to be virtually nonexistent. Based on our model specification and estimates, we find little indication that the current employer-based health insurance system causes individuals to pass up productivity-improving job opportunities.

Due to data limitations and also for reasons of tractability we have decided to only consider whether health insurance is provided or not and additionally assume that the employer’s direct cost of purchasing health insurance is exogenously determined. In reality the provision of health insurance involves many complicating features, both at the plan level and with respect to the costs that employers face. In particular, plans may cover both the worker (who supplies the productivity) and his family. Implicit in our empirical work is the assumption that health insurance coverage is extended to other family members. Moreover, for various reasons insurance contracts usually involve cost-sharing and risk-sharing features (e.g., deductibles, co-payment rates, and annual maximums, etc.). While these features are undoubtedly important factors in the decision-making process, the data requirements necessary to consider these elements are well beyond the scope of any currently available data set. In a similar vein, employers can either purchase coverage from an insurance provider with whom they may be able to bargain over the premiums based on employee demographics or self-insure. By allowing firm-level heterogeneity in the cost of health insurance provision we are capturing (in an admittedly indirect manner) some of these features. Lastly, although perhaps most importantly, our model ignores the relative tax advantage of compensation in the form of health insurance benefits. While the favored tax status of health insurance affects the wage and health insurance distribution, we argue that this cannot be the entire explanation for the role employers play in the provision of health insurance in the United States and the inclusion of tax parameters will not change the qualitative features of our model.

The remainder of the paper is structured as follows. In Section 2 we develop our search-theoretic model of the labor market with matching and bargaining which produces an equilibrium distribution of wages and health insurance status. Section 3 contains a discussion of the data used to estimate the equilibrium model, while Section 4 develops the econometric methodology. Section 5 presents

the estimates of the primitive parameters and the implications of estimates for observable duration and wage distributions. We also develop formal measures of the extent of “inefficient” turnover, and use our estimates to compute them. In Section 6 we offer some concluding remarks.

## 2 A Model of Health Insurance Provision and Wage Determination

In this section we describe the behavioral model of labor market search with matching and bargaining. The model is formulated in continuous time and assumes stationarity of the labor market environment. We begin by laying out the structure of the most general model we estimate and then proceed to characterize some important properties of the equilibrium. We attempt to provide some intuition regarding empirical implications of the model through graphical illustrations of equilibrium outcomes in the specification that ignores heterogeneity on the supply and demand sides of the market.

The key premise of the model is that health insurance has a positive impact on the productivity of the match. As is standard in most search-matching-bargaining frameworks, the instantaneous value of a worker-firm pairing is determined by a draw (upon meeting) from a nondegenerate distribution  $G(\theta)$ . This match value persists throughout the duration of the employment relationship as long as the individual remains “healthy.” A negative health shock while employed at match value  $\theta$  reduces the value of the match to 0 and results in what we will consider to be an exogenous dissolution of the employment relationship.<sup>3</sup> Thus an adverse health shock is considered to be one, potentially important, source of job terminations into unemployment. To keep the model tractable we have assumed that a negative health shock on one job does not affect the labor market environment of the individual after that job is terminated. Thus one should think of these health shocks as being largely employer- or job task-specific.

The role of health insurance in reducing the rate of separations into unemployment is presumed to result from covered employees more intensively utilizing medical services than non-covered employees. As a result, the rate of separations due to an inability to perform the job task associated with the match  $\theta$  will be lower among covered employees. If all other reasons for leaving a job and entering the unemployed state are independent of health insurance status, the wage, and the match value, then  $\eta_1 < \eta_0$ , where  $\eta_d$  is the flow rate from employment into unemployment for those in health insurance status  $d$ , with  $d = 1$  for those with employer-provided health insurance and  $d = 0$  for those who are uncovered. In this manner the purchase of health insurance can extend the expected life of the match for any given match value  $\theta$  through its “direct,” but stochastic, impact on health status. We will also consider other indirect effects of health insurance on match longevity that operate through a sorting mechanism.

Individuals are assumed to possess an instantaneous (indirect) utility function given by

$$u_\xi(w, d) = w + \xi d,$$

where  $\xi \geq 0$ . Individuals of type  $\xi = 0$  will then behave as classic expected wealth maximizers and exhibit only a “derived demand” for health insurance as a productive factor in an employment relationship. Those individuals with  $\xi > 0$  have some “private” demand for health insurance and maximize a slightly different objective function. We assume that the population distribution of preference types is given by  $H(\xi)$ .

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<sup>3</sup>It is not strictly necessary that the value of the match be reduced to 0, since any new value of  $\theta$  that would make unemployment more attractive than continued employment at the firm would do. The value 0 serves as a convenient normalization.

The heterogeneity on the demand side of the market relates to the cost to a firm of providing health insurance coverage to any one of its employees. While modeling the cost of providing such coverage is an interesting issue in itself, here we simply assume that these costs are exogenously determined. The premium paid by a firm is given by  $\phi$  where  $\phi \in \Phi \subseteq R_+$ . We denote the population distribution of firm types by  $F(\phi)$ .

Given the nature of the data available to us (from the supply side of the market), firms are treated as relatively passive agents throughout. In particular, we assume that the only factor of production is labor, and that the total output of the firm is simply the sum of the productivity levels of all of its employees. Then if the firm “passes” on the applicant – that is, does not make an employment offer – its “disagreement” outcome is 0 [it earns no revenue but makes no wage payment]. With the additional assumption that there are no fixed costs of employment to firms, the implication is that employment contracts are negotiated between workers and firms on an individualistic basis, that is, without reference to the composition of the firm’s current workforce.

All individuals begin their lives in the nonemployment state, and we assume that it is optimal for them to search. The instantaneous utility flow in the nonemployment state is  $b$ , which can be positive or negative. When an unemployed searcher and a firm meet, which happens at rate  $\lambda_n$ , the productive value of the match  $\theta$  is immediately observed by both the applicant and the firm as are the firm and searcher types,  $\phi$  and  $\xi$ , respectively. After both parties have been fully informed, a division of the match value is proposed using a Nash bargaining framework. If both parties realize a positive surplus the match is formed, and if not the searcher continues looking for an acceptable match. Let  $V_\xi^N$  denote the value of unemployed search to a searcher of type  $\xi$ , and denote by  $Q_\xi(\theta, \phi)$  the value of the match if the searcher receives all of the surplus. Then since the disagreement value of the firm is 0, all matches with  $Q_\xi(\theta, \phi) \geq V_\xi^N$  will be accepted by an unemployed searcher of type  $\xi$  and a type  $\phi$  firm.<sup>4</sup> Let the value of an employment contact between a type  $\xi$  worker and a type  $\phi$  employer with match value  $\theta$  to the employee be  $V_\xi^E(w, d; \theta, \phi)$  and let the value of the same match to the firm be given by  $V_\xi^F(w, d; \theta, \phi)$ . Then given an acceptable match, the wage and health insurance status of the employment contract are determined by the solution to the Nash bargaining game

$$(\hat{w}_\xi, \hat{d}_\xi)(\theta, \phi, V_\xi^N) = \arg \max_{w, d} \Xi_\xi(w, d; \theta, \phi, V_\xi^N). \quad (1)$$

The Nash bargaining objective function is given by

$$\Xi_\xi(w, d; \theta, \phi, V_\xi^N) = (V_\xi^E(w, d; \theta, \phi) - V_\xi^N)^\alpha V_\xi^F(w, d; \theta, \phi)^{1-\alpha} \quad (2)$$

where  $\alpha \in (0, 1)$  is the bargaining power of the individual.

Employed agents meet new potential employers at rate  $\lambda_e$ . To keep the model tractable we assume that there is full information among all parties as to the characteristics associated with the current match  $(\theta, \phi)$  and the potential match  $(\theta', \phi')$ , as well as the worker’s type  $\xi$ . This means that each firm knows the match value of the individual at the other firm with which it is competing for the worker’s services as well as that firm’s type. While these are strong informational assumptions, they are relatively inconsequential for the empirical analysis conducted below given the nature of the data available to us.

We now consider the rent division problem facing a currently employed agent who encounters a new potential employer. Assume that a currently employed type  $\xi$  individual faces two potential employers with characteristics,  $(\theta, \phi)$  and  $(\theta', \phi')$ , where  $Q_\xi(\theta', \phi') \geq Q_\xi(\theta, \phi) \geq V_\xi^N$ . Under our bidding mechanism, the individual will end up accepting the match at the type  $\phi'$  employer after

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<sup>4</sup>This claim is predicated on  $V_\xi^N > 0$ , which we assume to be the case.

the “last” offer by the type  $\phi$  firm. The idea is that the type  $\phi'$  employer can match any feasible offer (i.e., any  $(w, d)$  such that  $V_\xi^F(w, d; \theta, \phi) \geq 0$ ) made by the type  $\phi$  firm and will therefore “win” the worker’s services. The value of the offer of the dominated firm serves as the threat point of the employee in the Nash bargaining problem faced by the employee with the winning firm. When this is the case, the Nash bargaining objective function is given by

$$\Xi_\xi(w, d; \theta', \phi', \theta, \phi) = (V_\xi^E(w, d; \theta', \phi') - Q_\xi(\theta, \phi))^\alpha V_\xi^F(w, d; \theta', \phi')^{1-\alpha} \quad (3)$$

and the new equilibrium wage and health insurance pair will be given by

$$(\hat{w}_\xi, \hat{d}_\xi)(\theta', \phi', \theta, \phi) = \arg \max_{w, d} \Xi_\xi(w, d; \theta', \phi', \theta, \phi). \quad (4)$$

The firm’s value of the current employment contract is defined as:

$$\begin{aligned} V_\xi^F(w, d; \theta, \phi) &= (1 + \rho\varepsilon)^{-1} \{(\theta - w - d\phi)\varepsilon + \eta_d\varepsilon \times 0 \\ &\quad + \lambda_e\varepsilon \int_{\Phi} \int_{\hat{\theta}_\xi(w, d, \tilde{\phi})}^{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^F(\theta, \phi, \tilde{\theta}, \tilde{\phi}) dG(\tilde{\theta}) dF(\tilde{\phi}) \\ &\quad + \lambda_e\varepsilon \int_{\Phi} G(\hat{\theta}_\xi(w, d, \tilde{\phi})) dF(\tilde{\phi}) \times V_\xi^F(w, d; \theta, \phi) \\ &\quad + \lambda_e\varepsilon \int_{\Phi} \tilde{G}(\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})) dF(\tilde{\phi}) \times 0 \\ &\quad + (1 - \lambda_e\varepsilon - \eta_d\varepsilon) V_\xi^F(w, d; \theta, \phi) + o(\varepsilon)\}, \end{aligned} \quad (5)$$

where  $\hat{V}_\xi^F(\theta, \phi, \tilde{\theta}, \tilde{\phi}) = V_\xi^F(\hat{w}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}), \hat{d}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}); \theta, \phi)$  represents the equilibrium value to a type  $\phi$  firm of the productive match  $\theta$  when the type  $\xi$  worker’s next best option has characteristics  $(\tilde{\theta}, \tilde{\phi})$ . The function  $\hat{\theta}_\xi(w, d, \tilde{\phi})$  is defined as the maximum value of  $\tilde{\theta}$  for which the contract  $(w, d)$  would leave a type  $\tilde{\phi}$  firm with no profit given that the individual is type  $\xi$ . This value is implicitly defined by the equation

$$V_\xi^F(w, d; \hat{\theta}_\xi(w, d, \tilde{\phi}), \tilde{\phi}) = 0.$$

Any encounter with a potential type  $\tilde{\phi}$  firm in which the match value is less than  $\hat{\theta}_\xi(w, d, \tilde{\phi})$  will not be reported by the employee; any new contact with a match value greater than  $\hat{\theta}_\xi(w, d, \tilde{\phi})$  will be reported to the current firm and will result in either a renegotiation of the current contract or a separation. When the new potential employer can match any offer extended by the current firm such that  $Q_\xi(\tilde{\theta}, \tilde{\phi}) > Q_\xi(\theta, \phi)$ , a separation will occur. That is, any new match  $\tilde{\theta} > \bar{\theta}_\xi(\theta, \phi, \tilde{\phi})$  will induce the worker to quit where the critical match is implicitly defined by

$$Q_\xi(\bar{\theta}_\xi(\theta, \phi, \tilde{\phi}), \tilde{\phi}) = Q_\xi(\theta, \phi).$$

After rearranging terms and taking limits, we have

$$\begin{aligned} V_\xi^F(w, d; \theta, \phi) &= [\rho + \eta_d + \lambda_e \int_{\Phi} \tilde{G}(\hat{\theta}_\xi(w, d, \tilde{\phi})) dF(\tilde{\phi})]^{-1} \\ &\quad \times \{ \theta - w - d\phi \\ &\quad + \lambda_e \int_{\Phi} \int_{\hat{\theta}_\xi(w, d, \tilde{\phi})}^{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^F(\theta, \phi, \tilde{\theta}, \tilde{\phi}) dG(\tilde{\theta}) dF(\tilde{\phi}) \}. \end{aligned} \quad (6)$$



For the employee, the value of employment at a current match  $(\theta, \phi)$  and wage and health insurance provision status  $(w, d)$  is given by

$$\begin{aligned}
V_\xi^E(w, d; \theta, \phi) &= (1 + \rho\varepsilon)^{-1} \{ (w + \xi d)\varepsilon + \eta_d \varepsilon V_\xi^N \\
&+ \lambda_e \varepsilon \int_{\Phi} \int_{\hat{\theta}_\xi(w, d, \tilde{\phi})}^{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\theta, \phi, \tilde{\theta}, \tilde{\phi}) dG(\tilde{\theta}) dF(\tilde{\phi}) \\
&+ \lambda_e \varepsilon \int_{\Phi} \int_{\hat{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, \theta, \phi) dG(\tilde{\theta}) dF(\tilde{\phi}) \\
&+ \lambda_e \varepsilon \int_{\Phi} G(\hat{\theta}_\xi(w, d, \tilde{\phi})) dF(\tilde{\phi}) \times V_\xi^F(w, d; \theta, \phi) \\
&+ (1 - \lambda_e \varepsilon - \eta_d \varepsilon) V_\xi^E(w, d; \theta, \phi) + o(\varepsilon) \}
\end{aligned} \tag{7}$$

where  $\hat{V}_\xi^E(\theta, \phi, \tilde{\theta}, \tilde{\phi}) = V_\xi^E(\hat{w}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}), \hat{d}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}); \theta, \phi)$  represents the equilibrium value to a type  $\xi$  worker employed at a match with characteristics  $(\theta, \phi)$  when his next best option is defined by  $(\tilde{\theta}, \tilde{\phi})$ . Note that when an employee encounters a firm with a new match value lower than his current one but sufficiently great that it can be used to increase his share of the match surplus (i.e., a new draw  $\tilde{\theta}$  such that  $\bar{\theta}_\xi(\theta, \phi, \tilde{\phi}) > \tilde{\theta} > \hat{\theta}_\xi(w, d, \tilde{\phi})$ ), his new value of employment at the current firm becomes  $V_\xi^E(\hat{w}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}), \hat{d}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}); \theta, \phi)$ .

The receipt of outside offers during an employment match provides a rationale for wage growth on the job, as well as allowing for the possibility for a change in health insurance coverage. In fact, while the bargaining power parameter  $\alpha$  is often the focus of attention when examining the labor's share of firm revenues, competition between firms for workers can result in a very high labor share even in the presence of low bargain power. This point is clearly made in the empirical results of Postel-Vinay and Robin (2002), where the bargaining power of searchers is assumed to be zero, and in the empirical results presented below. In both cases, substantial amounts of wage growth are indicated with small or no bargaining power as long as employers are forced to bid against each other for a worker's services sufficiently often.

In addition, when the potential surplus to the worker at the newly-contacted firm exceeds that of the current firm (i.e., a new draw  $\tilde{\theta}$  such that  $\tilde{\theta} > \bar{\theta}_\xi(\theta, \phi, \tilde{\phi})$ ), mobility results. The value of employment at the new firm is given by  $V_\xi^E(\hat{w}_\xi(\tilde{\theta}, \tilde{\phi}, \theta, \phi), \hat{d}_\xi(\tilde{\theta}, \tilde{\phi}, \theta, \phi); \tilde{\theta}, \tilde{\phi})$  – that is, the match value at the current firm becomes the determinant of the “threat point” faced by the new firm and plays a role in the determination of the new wage. Finally, when the match value at the new firm is less than  $\hat{\theta}_\xi(w, d, \tilde{\phi})$ , the contact is not reported to the current firm since it would not result in any improvement in the current contract. Because of this selective reporting, the value of employment contracts must be monotonically increasing both within and across consecutive job spells. Declines can only be observed following a transition into the unemployment state.

After rearranging terms and taking limits, we have

$$\begin{aligned}
V_\xi^E(w, d; \theta, \phi) &= [\rho + \eta_d + \lambda_e \int_{\Phi} \tilde{G}(\hat{\theta}_\xi(w, d, \tilde{\phi})) dF(\tilde{\phi})]^{-1} \\
&\times \{ w + \xi d + \eta_d V_\xi^N \\
&+ \lambda_e \int_{\Phi} \int_{\hat{\theta}_\xi(w, d, \tilde{\phi})}^{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\theta, \phi, \tilde{\theta}, \tilde{\phi}) dG(\tilde{\theta}) dF(\tilde{\phi}) \\
&+ \lambda_e \int_{\Phi} \int_{\hat{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, \theta, \phi) dG(\tilde{\theta}) dF(\tilde{\phi}) \}.
\end{aligned} \tag{8}$$

The model is closed after specifying the value of nonemployment,  $V_\xi^N$ , and the total surplus of the match,  $Q_\xi(\theta, \phi)$ . Passing directly to the steady state representation of  $V_\xi^N$ , we have

$$V_\xi^N = [\rho + \lambda_n \tilde{G}(\theta_\xi^*)]^{-1} \times \{b + \lambda_n \int_{\Phi} \int_{\theta_\xi^*} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, V_\xi^N) dG(\tilde{\theta}) dF(\tilde{\phi})\} \quad (9)$$

where  $\theta_\xi^*$  is the critical match value associated with the decision to initiate an employment contract for a type  $\xi$  individual and  $\hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, V_\xi^N) = V_\xi^E(\hat{w}_\xi(\tilde{\theta}, \tilde{\phi}, V_\xi^N), \hat{d}_\xi(\tilde{\theta}, \tilde{\phi}, V_\xi^N); \tilde{\theta}, \tilde{\phi})$  represents the equilibrium value to a type  $\xi$  worker employed at a match with characteristics  $(\tilde{\theta}, \tilde{\phi})$  when coming out of the nonemployment state.<sup>5</sup>

The total surplus of the match is given by

$$Q_\xi(\theta, \phi) = V_\xi^E(\hat{w}_\xi(\theta, \phi, \theta, \phi), \hat{d}_\xi(\theta, \phi, \theta, \phi); \theta, \phi),$$

where

$$(\hat{w}_\xi, \hat{d}_\xi)(\theta, \phi, \theta, \phi) = (\hat{w}_\xi, \hat{d}_\xi)(\theta, \phi).$$

When the worker receives the entire surplus of the match the equilibrium wage function is particularly simple to derive. Setting  $V_\xi^F(w, d; \theta, \phi) = 0$  and recognizing that there is no room for renegotiation, we have

$$\theta - w - d\phi = 0 \Rightarrow \hat{w}_\xi(\theta, \phi) = \theta - \phi \hat{d}_\xi(\theta, \phi). \quad (10)$$

Then

$$Q_\xi(\theta, \phi) = [\rho + \eta(\hat{d}_\xi(\theta, \phi)) + \lambda_e \int_{\Phi} \tilde{G}(\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})) dF(\tilde{\phi})]^{-1} \times \{\theta - (\phi - \xi) \hat{d}_\xi(\theta, \phi) + \eta(\hat{d}_\xi(\theta, \phi)) V_\xi^N + \lambda_e \int_{\Phi} \int_{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, \theta, \phi) dG(\tilde{\theta}) dF(\tilde{\phi})\}. \quad (11)$$

where we have used the fact that  $\hat{\theta}_\xi(\hat{w}_\xi(\theta, \phi), \hat{d}_\xi(\theta, \phi), \tilde{\phi}) = \bar{\theta}_\xi(\theta, \phi, \tilde{\phi})$ .

We can now characterize the wage and health insurance decisions with the following set of results.

**Proposition 1** *Let  $Q_\xi(\theta', \phi') > Q_\xi(\theta, \phi)$  where  $(\theta, \phi)$  represent the characteristics of the next best option available to a type  $\xi$  employee at the time a bargain is made. The decision to acquire health insurance is only a function of  $(\theta', \phi', \xi)$ .*

**Proof:** See Appendix A.

The decision to acquire health insurance is an efficient one in the sense that it only depends on characteristics of the current match. The driving force behind this result is the manner in which the “private” demand for health insurance enters the individual’s contemporaneous utility function. It enters linearly, and essentially combines with the firm’s cost characteristic  $\phi$  to produce a net health insurance cost of  $\phi - \xi$ . The linearity implies the health insurance decision is never revisited as a result of a new division of the match surplus. Thus the health insurance decision is made solely to maximize the total surplus from the match and is efficient given the cost of health insurance  $\phi - \xi$ .

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<sup>5</sup>We are implicitly assuming that for every pair of worker-firm types  $(\xi, \phi)$ , there exist some employment contracts that do not result in the purchase of health insurance coverage. Without this assumption, the critical match would depend on the type of firm the individual meets out of nonemployment.

**Proposition 2** *Assume there exist employment contracts between a type  $\phi$  employer and type  $\xi$  employee that do not result in the purchase of health insurance. The decision to initiate an employment contract can be characterized by a unique critical match  $\theta_\xi^*$ . Furthermore, when a type  $\xi$  individual works for a type  $\phi$  employer the decision to purchase health insurance coverage can be characterized by a unique critical match,  $\theta_\xi^{**}(\phi)$ .*

**Proof:** See Appendix B.

This result simply establishes the existence of critical value strategies for the bargaining pair. The assumption that there exists some acceptable match values that do not result in health insurance coverage for all pairs  $(\phi, \xi)$  simplifies the characterization of labor market equilibrium and the computational task we face. There would be no conceptual difficulty in relaxing this assumption.

When there exists firm heterogeneity “inefficient” mobility decisions will occur, in general. By an “inefficient” mobility decision we mean that when confronted with a choice between  $\theta$  and  $\theta'$ , where  $\theta' > \theta$ , the individual (optimally) opts for  $\theta$ .<sup>6</sup> The reason for this is that, from a type  $\xi$  searcher’s perspective, an employment contact now is characterized by the two values  $(\theta, \phi)$ . Since the value of the potential match is a function of both, when confronted with a choice between  $(\theta', \phi')$  and  $(\theta, \phi)$ , the decision rule will not generally be only a function of  $\theta'$  and  $\theta$ .

The potential for inefficiency, by which we really only mean that  $(\theta, \theta')$  is not a sufficient statistic for the mobility decision, only arises in certain cases. Clearly, when two potential matches exist with the same type of firm<sup>7</sup> the individual will always choose the one with the highest value of  $\theta$ , or

$$Q_\xi(\theta', \phi) > Q_\xi(\theta, \phi) \Leftrightarrow \theta' > \theta, \forall \phi.$$

Thus inefficient mobility decisions can never occur when the searcher’s choice is between two firms of the same type. In this case the values  $(\theta, \theta')$  are sufficient for characterizing the mobility decision.

Now consider the case in which the agent faces a choice between firms of different cost types. Say that his current match is at a lower cost firm than the potential match,  $\phi < \phi'$ . Since the value of employment is non-increasing in the cost of health insurance, the match values at the higher cost firm will have to be at least as large as the match value at the lower cost firm for mobility to occur. If the individual would not purchase health insurance at either firm then the types of the firms are irrelevant. In such a case, the match values at the two firms are (conditionally) sufficient for the mobility decision and no inefficient mobility can result (and in this case the value of working at either firm at the same match value is equal). Now consider the case in which the match value at the lower cost firm results in the purchase of health insurance. Let the current employment match be characterized by  $(\theta, \phi)$  and the potential employment match be characterized by  $(\theta', \phi')$ . If both matches would result in health insurance being purchased, the agent must be compensated for the increased cost of health insurance. In this case, there exists a critical value  $\bar{\theta}_\xi(\theta, \phi, \phi') > \theta$  such that  $Q_\xi(\bar{\theta}_\xi(\theta, \phi, \phi'), \phi') = Q_\xi(\theta, \phi)$  for which the agent will be indifferent between the two firms. It is also possible that there could exist a draw of  $\theta'$  at the higher cost firm that resulted in mobility but did not result in health insurance. In such an instance it is also necessary to compensate the individual for the loss of health insurance (whatever the value of  $\xi$ ), and this also implies that the critical match value  $\bar{\theta}_\xi(\theta, \phi, \phi') > \theta$ . Thus there will always be a “wedge” between the critical match value required for mobility to a higher cost firm and the current match value  $\theta$  at the lower cost firm whenever the individual has health insurance. This wedge generates something analogous

<sup>6</sup>By inefficiency here we mean that the highest match value is not always taken. In the context of this model it is doubtful that this is the correct criterion to use as is discussed more fully below.

<sup>7</sup>For the likelihood that two firms of the same type would be bidding against each other to be nonzero it is necessary that the distribution of firm types to have mass points. This is the case in the econometric specification we employ.

to what is known as “job lock” in the empirical literature that studies mobility, wage, and health insurance outcomes. This occurs when an individual passes on a higher match at a higher cost firm to keep a lower match at a lower cost firm.

The other possibility for inefficient mobility decisions occurs when the agent is currently employed at a higher cost firm  $(\theta, \phi)$  and meets a low cost firm  $(\theta', \phi')$  where  $\phi' < \phi$ . If the agent would have no health insurance at either firm, then the mobility decision is made on the basis of the  $\theta$  and  $\theta'$  draws exclusively and is consistent with efficiency. When the current match at the higher cost firm provides health insurance, then there once again exists a wedge between the current value of the match at the higher cost firm and that required for mobility to the lower cost firm. As before, define  $\bar{\theta}_\xi(\theta, \phi, \phi')$  such that  $Q_\xi(\bar{\theta}_\xi(\theta, \phi, \phi'), \phi') = Q_\xi(\theta, \phi)$  and note that  $\bar{\theta}_\xi(\theta, \phi, \phi') < \theta$ . When the match at the higher cost firm does not result in health insurance, there still exists a wedge when the match at the lower cost firm does. When an individual leaves a higher cost firm match for a lower-valued match at a lower cost firm we may term this as “job push” as in the empirical literature on the subject. Clearly “job lock” and “job push” are two sides of the same coin in our framework, with the distinction between the two solely arising from whether the current match is with a lower cost or higher cost firm.

The model is sufficiently complex that comparative statics results are not readily available. In light of this we will only graphically display some of the implications of the model. Due to the relatively complicated renegotiation process it is difficult to solve for the steady state wage distribution, which is the cross-sectional distribution that would be observed after the labor market had been running for a sufficiently long period of time. The distributions that are plotted are all based on some of the model estimates obtained below; the specific model utilized for these illustrative purposes is the simplest one in which there is no heterogeneity on either side of the market and there is symmetric bargaining, i.e.,  $\alpha = 0.5$ .

Figure 1 plots the estimated probability density function of job matches in the population, which is assumed to belong to the lognormal family. The lower dotted line represents the critical match value for leaving unemployment,  $\theta^*$ , which is estimated to be approximately 7.76. The dotted line to the right represents  $\theta^{**}$ , which is the critical match value for the match to provide health insurance coverage (its estimated value is 13.95). The likelihood that an unemployed searcher who encounters a potential employer will accept a job is the measure of the area to the right of  $\theta^*$ . The probability that an unemployed searcher accepts a job that doesn’t provide health insurance is then given by the probability mass in the area between the two critical values divided by the probability of finding an acceptable match, which in this case is 0.43.

The wage densities (associated with the first job after leaving unemployment) conditional on health insurance status are displayed in Figure 2.a. We can clearly discern the area of overlap between these two densities. Since both of these p.d.f.s are derived from slightly different mappings of the same p.d.f.  $g(\theta)$ , it is not surprising that they share general features in terms of shape. Note that the wage density conditional on not having health insurance is always defined on a finite interval  $[\underline{w}^{(0)}, \bar{w}^{(0)})$ , while the range of wages conditional on having health insurance is unbounded as long as the matching distribution  $G$  has unbounded support. These general characteristics also characterize the conditional steady state wage distributions.

In Figure 2.b we plot the marginal wage density associated with the first wage observed following unemployment. The interval of overlap in the wage distribution adds a “bulge” to a density that otherwise resembles the parent lognormal density. Recall that wages in the interval of the bulge are the only ones that can *either* be associated with health insurance or not. Wages in the right tail are always associated with jobs that provide health insurance while those to the left of the bulge are associated with jobs that do not provide health insurance.

Figure 3 contains graphs of the simulated steady state conditional (on health insurance status)

and unconditional wage distributions. The simulation on which these histograms are based is for one million labor market careers. The figures plot the equilibrium wage distributions from the model, i.e., they do not include measurement error.

Figure 3.a plots the steady state conditional wage distributions. For individuals in jobs covered by health insurance the shape of the distribution is rather unremarkable. The lowest value of the wage in this case is \$9.12 using point estimates of the model parameters. The steady state wage distribution for individuals holding jobs not providing health insurance is more unusual. We know that this distribution is bounded, and we note a precipitous drop in the “density” at relatively high wages in the support of the distribution. This drop is due to the small proportion of histories that could lead to such a high wage rate. For an individual to have a high wage without health insurance implies that he is working at a firm with a relatively high value of  $\theta$  but one that is less than  $\theta^{**}$ . If he is getting a high share of the surplus at this match, this firm has to bid against other firm(s) with match values less than  $\theta$  but sufficiently close to it. In our case, since the critical match value is 13.95, the highest wage that could possibly be observed without health insurance is \$13.95.

The unconditional steady state wage distribution is plotted in Figure 3.b. As is to be expected, the upper tail of the density has a shape solely inherited from the relevant part of the conditional (on health insurance) wage density. Overall, the density is not very much at odds with what we typically observe in cross-sectional representative samples. The one possible exception to this claim pertains to the small but perceptible notches above and below the interval of overlap in the support of the two conditional wage distributions. These discontinuities in the density would be hidden if any amount of measurement error was added to the model, as it is when constructing the econometric specification below.

Though the model tautologically implies higher *involuntary* exits from jobs without health insurance, there are two possible routes by which any job spell can end. Given the efficient separations implied by the search and bargaining process in the absence of firm heterogeneity, we know that *voluntary* exits from a job spell occur whenever a job with a higher match value is located (independent of whether the current job provides health insurance or not). For the model with no worker or firm heterogeneity, the instantaneous exit rate from a job with match value  $\theta$  ( $\theta \geq \theta^*$ ) is given by

$$r(\theta) = \eta_0\chi[\theta^* \leq \theta < \theta^{**}] + \eta_1\chi[\theta \geq \theta^{**}] + \lambda_e\tilde{G}(\theta), \quad (12)$$

so that the duration of time that individuals spend in a job spell conditional on the current match value is

$$f_e(t_e|\theta) = r(\theta) \exp(-r(\theta)t_e), \quad t_e > 0.$$

Then the density of durations in a given job spell conditional upon health insurance status is

$$f_e(t_e|d) = \int f_e(t_e|\theta) dG(\theta|d).$$

The corresponding conditional hazard,  $h_e(t_e|d) = f_e(t_e|d)/\tilde{F}_e(t_e|d)$ , exhibits negative duration dependence for both  $d = 0$  and  $d = 1$ . However, because  $\eta_0 > \eta_1$  and because the lowest value of  $\theta$  for  $d = 1$  exceeds the greatest value of  $\theta$  for  $d = 0$ , the hazard out of jobs covered by health insurance exceeds the hazard out of jobs with health insurance for any value of  $t_e$ . Note that the limiting value (as  $t_e \rightarrow \infty$ ) for the hazard in jobs without health insurance is  $\lim_{t \rightarrow \infty} h_e(t_e|d = 0) = \eta_0 + \lambda_e\tilde{G}(\theta^{**})$ , while the corresponding limiting value for jobs with health insurance is  $\lim_{t \rightarrow \infty} h_e(t_e|d = 1) = \eta_1$ .

The job exit rates conditional on the current wage as well as health insurance status also have interesting properties. For simplicity, consider the exit rate from the first job following an unemployment spell (outside options are identical for these types of spells in a model with no

individual or firm heterogeneity). For a given  $(w, d)$  the hazard out of the job will be constant. We can write the hazard as

$$r(w, d) = \eta_d + \lambda_e \tilde{G}(\theta(w, d)).^8 \quad (13)$$

If it was the case that there was no overlap in the supports of the conditional wage distributions by health insurance, then  $w$  would be a sufficient statistic for the rate of leaving the job since we could write  $d(w) \Rightarrow r(w, d) = r(w, d(w)) = r(w)$ . However, with overlap in the support of the conditional wage distributions this is no longer the case and the pair  $(w, d)$  are required to completely characterize the job exit rate. We illustrate this point in Figure 4. For the set of wages consistent with either health insurance state, the value of  $d$  provides information on the value of  $\theta$  associated with the match. For example, individuals paid \$10 an hour could be receiving health insurance or not. Those with health insurance are less likely to leave the job both because they are less likely to receive a negative health shock but also because the  $\theta$  value associated with a wage of 10 and health insurance is greater than the  $\theta$  value associated with a wage of 10 and no health insurance. In contrast with claims in the empirical literature on job lock, the fact that the hazard rate out of a job that is covered by health insurance is lower than the exit rate from one that is not (conditional on the wage or not) does not necessarily indicate that health insurance status distorts the mobility decision.

### 3 Data and Descriptive Statistics

Data from the 1996 panel of the Survey of Income and Program Participation (SIPP) are used to estimate the model. The SIPP interviews individuals every four months for up to twelve times, so that at most an individual will have been interviewed (relatively frequently) over a four year period. The SIPP collects detailed monthly information regarding individuals' demographic characteristics and labor force activity, including earnings, number of weeks worked, average hours worked, as well as whether the individual changed jobs during each month included in the survey period. In addition, at each interview date the SIPP gathers data for a variety of health insurance variables, including whether an individual's private health insurance is employer-provided.<sup>9</sup> With the exception of the private demand for health insurance, the primitive parameters of the model developed in this paper are assumed to be independent of observable individual characteristics. Though in principle it would not be difficult to allow the primitive parameters to depend on observables, we instead have attempted to define a sample that is relatively homogeneous with respect to a number of demographic characteristics. In particular, only white males between the ages of 25 and 54 with at least a high school education have been included in our subsample. In addition, any individual who reports attendance in school, self-employment, military service, or participation in any government welfare program (i.e., AFDC, WIC, or Food Stamps) over the sample period is excluded.<sup>10</sup> Although the format of the SIPP data makes the task of defining job changes fairly difficult, in other respects

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<sup>8</sup>We are assuming that  $(w, d)$  are the wage and health insurance pair negotiated when entering the job from the unemployment state. The individual can meet other potential employers that will not lead to a move but will result in a renegotiation in the wage. Allowing for renegotiations leads to a more complex mapping between the current  $(w, d)$  pair and  $\theta$ . In this case, the mapping will be random rather than deterministic.

<sup>9</sup>There are several issues involved in constructing a meaningful employer-provided health insurance variable. First, there is a timing problem since the insurance variable can change values only at the interview months, while a job change can occur at any time over a four month period. Second, there are job spells in which the individual reports employer-provided coverage for some part of the spell and no coverage for the remainder of the spell. We have made a good faith effort to accurately match job and health insurance spells, but we have been forced to make several judgment calls while constructing the event history data set.

<sup>10</sup>Some individuals, about 3 percent of the sample, had missing data at some point during the panel. Since estimation depends critically on having complete labor market histories we have excluded these cases as well.

the survey information is well-suited to the requirements of this analysis since it follows individuals for up to four years and includes data on both wages and health insurance at each job held during the observation period.

Table 1 contains some descriptive statistics from the sample of individuals used in our empirical analysis. In Table 1.a we see that the sample consists of 10,121 individuals who meet the inclusion criteria discussed above. So as to minimize difficult initial conditions problems, the unit of analysis is a labor market “cycle,” which begins with an unemployment spell, which could be right-censored (i.e., may not end before the observation period is completed), and ends with the following right-censored or complete employment spell, if there is one.<sup>11</sup> We partition the full sample into two subsamples, one consisting of individuals who experienced unemployment at some point during the observation period and the other consisting of those who did not.<sup>12</sup> Approximately twenty-eight percent of the full sample, or 2,814 individuals, fall into the former group. For these individuals, we use information regarding the duration of time spent in the initial unemployment spell, the duration of time spent in the first job spell after the unemployment spell, and the wage and health insurance status of the first two jobs in the employment spell following unemployment. In addition, we use marital status and children dummies as observable factors that influence the probability of having a high “private” demand for health insurance, and we use the length of the sample window as an exogenous factor that affects the probability of being observed in the non-employment state sometime during the panel. For the 7,307 individuals in the full sample whom we never observe in the unemployment state, we do not consider any labor market information but do include marital status and children dummies and the length of their sample windows when conducting the empirical analysis. It is interesting to note the differences among individuals in the two groups. Sample members without an unemployment spell over their sample window are much more likely to be married and to have children. The lengths of the sample windows are not very different for the two subsamples.

The labor market data from the sample members with an unemployment spell provide a wealth of information regarding the relationship between health insurance coverage, wages, and job mobility. From Table 1.b we observe that a slight majority (50.7%) of unemployment spells end with a transition into a job that provides health insurance. Perhaps the most striking feature of the data is the difference in the average wages of jobs conditional on health insurance provision. Jobs with health insurance have a mean wage 41 percent higher than jobs without health insurance. In addition, we see that individuals who exit unemployment for a job with insurance are more likely to be married with children than individuals who take a job without health insurance.

From the information on the first job following an unemployment spell, displayed in Figure 1.c, it is quite clear that jobs with health insurance tend to last longer on average than jobs without health insurance. Another feature of the data that is interesting to note is the difference in initial wages for the various transitions out of jobs with health insurance. In particular, while the mean initial wage for all insured jobs is almost \$16, individuals who subsequently move into a job without insurance are earning \$11.41 on average. In addition, the mean wage in the subsequent uninsured job is \$16.14, well above the mean wage for uninsured jobs accepted directly out of unemployment.

Finally, note the difference in the average wages of insured and uninsured jobs that follow a job without insurance (Figure 1.d). Jobs without insurance have a mean wage that is almost 6 percent larger than jobs with insurance. This is in marked contrast to the relationship between the average

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<sup>11</sup>This approach was also taken by Wolpin (1992) and Flinn (2002).

<sup>12</sup>The sample window is the length of time an individual remains in the SIPP. While the maximum length of the sample window is four years (or 208 weeks), a majority (52%) of sample members do not participate in all 12 waves of the survey. We measure the sample window from the initiation of the survey until the individual first fails to complete the survey.

wages by health insurance status that are observed directly following an unemployment spell. The model constructed above is, on the face of it, consistent with all of these descriptive statistics, and in the following section we describe our attempt to recover the primitive parameters of the model from these data.

## 4 Econometric Specification

As noted above, the information used in the estimation process is best defined in terms of what we will refer to as an employment cycle. Such a cycle begins with an unemployment spell and is followed by an employment spell, which itself consists of one or more job spells (defined as continuous employment with a specific employer). Under our model specification we know that wages will generally change at each change in employer and can also change during a job spell at the time an alternative offer arrives that does not result in mobility but that does result in renegotiation of the employment contract. In terms of our model, an employment cycle is defined in terms of the following random variables

$$t^u, \{t_k^e\}_{k=1}^S, \{w_m, t_m^w\}_{m=1}^M, \{d_q, t_q^d\}_{q=1}^Q$$

where  $t^u$  is the length of the unemployment spell,  $t_k^e$  is the length of the job spell with the  $k^{th}$  employer during the employment spell,  $w_m$  is the  $m^{th}$  wage observation of the  $M$  that are observed during the employment spell,  $t_m^w$  is the time that the  $m^{th}$  wage came into effect,  $d_q$  is the  $q^{th}$  health insurance status observed during the employment “cycle” of the  $Q$  distinct changes in status, and  $t_q^d$  is the time that the  $q^{th}$  health insurance status came into effect. Note that the total length of the employment spell (i.e., which is the length of the consecutive job spells) is  $t_e = \sum_k t_k^e$  and the number of observed wages during the employment spell is at least as great as the number of jobs, or  $M \geq S$ . The  $\{d_q\}_{q=1}^Q$  is an alternating sequence of 1’s and 0’s. Since we are assuming that no unemployed searcher will purchase health insurance, the process always begins with a 0 (since an employment cycle begins in the unemployment state). Other restrictions on the wage and health insurance processes will apply depending on the specification of searchers’ utility functions and the form of population heterogeneity.

Because of the unreliability of wage change information over the course of a job spell, in our estimation procedure we only employ wages observed at the beginning of a job spell and in terms of duration information we only use information on the duration of unemployment spells and the duration of job spells. Furthermore, to reduce the computational burden we consider (at most) the first two jobs in a given employment spell.

As is often the case when attempting to estimate dynamic models, we face difficult initial conditions problems. In our framework, and common to most stationary search models, entry into the unemployment state essentially “resets” the process. While we will utilize all cases in the data in estimating the model, our focus will be on those cases that contain an unemployment spell. The likelihood function is written in terms of the employment cycles referred to above, so that only those cases that contain an unemployment spell are “directly” utilized. Let  $\Psi$  take the value ‘1’ if a sample member experiences an unemployment spell at some point during their observation period and let it take the value ‘0’ when this is not the case. At the conclusion of our discussion of the likelihood contributions for sample members with  $\Psi = 1$  we will derive the likelihood of this event. For present purposes we simply state that it is a function of the length of the sample period, which we will denote  $T$ , and the individual’s type  $\xi$ . Then let us denote  $P(\Psi = 1|\xi, T)$  by  $\omega_\xi(T)$ . It is assumed that the length of the sample window is independently distributed with respect to all of the outcomes determined within the model.



For the sample cases in which  $\Psi = 1$  the data utilized in our estimation procedure is given by  $\{t^u, t_1^j, w_1, w_2, d_1, d_2\}$ , where the two wage and health insurance status observations are those in effect at the beginning of the relevant job spell. The likelihood for these observations is constructed using simulations of the equilibrium wage and health insurance process in conjunction with classical measurement error assumptions regarding observed beginning of spell wage rates and health insurance statuses. In particular, corresponding to any “true” wage  $w$  that is in existence at any point in time we assume that there is an observed wage given by

$$\tilde{w} = w \exp(\varepsilon), \quad (14)$$

where  $\varepsilon$  is an independently and identically (continuously) distributed random variable. Our econometric specification will posit that  $\varepsilon$  is normally distributed with mean 0, so that

$$\ln \tilde{w} = \ln w + \varepsilon, \quad (15)$$

and  $E(\ln \tilde{w}) = \ln w$ . In terms of the observation of health insurance status, we will assume that the reported health insurance status at any point in time,  $\tilde{d}$ , is reported correctly with probability  $\gamma$  and incorrectly with probability  $1 - \gamma$ , independently of the actual state. Thus  $\gamma = p(\tilde{d} = 1 | d = 1) = p(\tilde{d} = 0 | d = 0)$ .

Measurement error essentially serves three purposes in our estimation framework. First, it reflects the reality that there is a considerable amount of mismeasurement and misreporting in all survey data (though admittedly it is not likely to be exactly of the form we assume). Second, it serves to smooth over incoherencies between the model and the qualitative features of the data. For example, under certain specifications of the instantaneous utility function the model implies that the probability of moving directly from a job covered by health insurance to a job without insurance is a probability zero event. Data exhibiting such patterns will produce a likelihood value of 0 at all points in the parameter space. Measurement error makes such observations possible at all points in the parameter space.

The third usage is related to the simulation method of estimation. This method is most effective when based on a latent variable structure. In our case, the latent variables correspond to the simulated values of the variables that appear in the likelihood function, which themselves have a simple mapping into the observed values as a result of our i.i.d. measurement error assumptions. Thus any simulated value will have positive likelihood no matter what the observed value. In this sense, measurement error serves as a “smoother” of the likelihood. Because of its particular properties, measurement error is not introduced into the duration measures. By the structure of the model, it is not necessary to smooth the likelihood with respect to this information.

Throughout the empirical section we assume that the distributions of individual demands and firm costs are both discrete. Firm cost types assume the values  $0 < \phi_1 < \phi_2$ , with the probability that a randomly selected firm has a high cost of providing health insurance given by  $P_F(\phi = \phi_2) = \pi$ . On the individuals’ side of the market, we assume that there are two levels of private demand, with  $0 = \xi_1 < \xi_2$ , and with the probability that the individual has a positive “private” demand for health insurance given by  $P_H(\xi = \xi_2) = \delta$ .

The unit of analysis in our likelihood function is the individual. Individuals may be heterogeneous with respect to their private demand for insurance, though we do assume that their type does not change over the course of the sample period. This implies that the decision rules used by any given agent will be time invariant. Recall that for an individual of type  $\xi$  we denote the value of employment at a firm with match value  $\theta$  and cost type  $\phi$  when the next best alternative is at match value of  $\theta'$  at a firm of cost type  $\phi'$  by

$$\hat{V}_\xi^E(\theta, \phi, \theta', \phi').$$

The characteristics  $(\theta, \phi)$  correspond to those of the higher value employment contract (from the point of view of the individual). In the presence of firm heterogeneity it need not be the case that  $\theta \geq \theta'$ , as is true when  $\phi = \phi'$ .

Corresponding to each set of state variables  $(\theta, \phi, \theta', \phi')$  for an individual of type  $\xi$  is a unique wage and health insurance pair  $(\hat{w}_\xi, \hat{d}_\xi)(\theta, \phi, \theta', \phi')$ . For an individual of type  $\xi$  at a current job with characteristics  $(\theta, \phi)$  let the set of alternative matches that would dominate the current match be denoted by  $\Omega_\xi(\theta, \phi)$ . As we have demonstrated above, this set is always connected and can be parsimoniously characterized as follows. For any type  $\xi$  agent with a current match  $(\theta, \phi)$ , a potential match  $(a, b)$  dominates when

$$a > \bar{\theta}_\xi(\theta, \phi, b).$$

When  $\phi = b$ , so that the individual meets a potential employer of the same type as her current employer, then

$$\theta = \bar{\theta}_\xi(\theta, \phi, \phi)$$

for any type  $\xi$ . On the other hand, when  $\phi \neq b$  we have

$$\begin{aligned} \bar{\theta}_\xi(\theta, \phi_2, \phi_1) &\leq \theta \\ \bar{\theta}_\xi(\theta, \phi_1, \phi_2) &\geq \theta. \end{aligned}$$

The individual's type will affect the size of the match differential required for a move to take place in these cases, though even individuals with no private demand for health insurance ( $\xi = 0$ ) generally demand some differential.

Among the sample members for whom  $\Psi = 1$  we will discuss three qualitatively distinct cases. The first case, in which the observation period ends while the individual is still in an on-going unemployment spell, is the simplest. In this situation, the only contribution to the likelihood is the density of the right-censored unemployment spell. We will then discuss the second case, in which the individual has one job spell in the employment cycle, either due to the fact that he moves into unemployment at the conclusion of the first job spell or due to the fact that the first job spell is right-censored. In this case the likelihood contribution is defined with respect to the density of the completed unemployment spell, the observed wage and health insurance status at the initiation of the first job, and the length of the first job (be it censored or not). The final case is that in which the individual has two consecutive job spells following the completion of an unemployment spell. In this case, the likelihood contribution is defined with respect to the duration of the unemployment spell, the duration of the first job spell, and the wages and health insurance statuses associated with the first two jobs (at their onset). We shall now consider these cases in the order of their complexity.

## 4.1 Unemployment Only

Recall that as long as an individual of type  $\xi$  would accept some match values at each type of firm (differentiated in terms of  $\phi$ ) that would not result in the purchase of health insurance, the critical job acceptance match value for a type  $\xi$  person is independent of  $\phi$ . This value is denoted by  $\theta_\xi^*$ . Then the hazard rate associated with unemployment for an individual of type  $\xi$  is given by

$$h_\xi^u = \lambda_n \tilde{G}(\theta_\xi^*), \quad (16)$$

and the density of unemployment spell durations for a type  $\xi$  individual is

$$f_\xi^u(t^u) = h_\xi^u \exp(-h_\xi^u t^u), \quad (17)$$

where  $t^u$  is the duration of the unemployment spell in the observation period. Since the hazard function out of unemployment is constant given the individual's type, it is irrelevant whether or not we observe the beginning of the unemployment spell.<sup>13</sup> Then the probability that an unemployment spell of duration  $t^u$  is on-going at the end of the sample period (e.g., is right-censored) given the individual's type is

$$L_\xi^{(1)}(t^u, \Psi = 1|T) = \omega_\xi(T) \exp(-h_\xi^u t^u). \quad (18)$$

Let the probability that the individual is a "high demand type" be denoted  $\delta$ . Then the empirical likelihood in this case is given by

$$L^{(1)}(t^u, \Psi = 1|T) = \delta L_{\xi_2}^{(1)}(t^u, \Psi = 1|T) + (1 - \delta) L_{\xi_1}^{(1)}(t^u, \Psi = 1|T). \quad (19)$$

## 4.2 One Job Spell Only

For all likelihood contributions that involve job spells we utilize simulation methods. We will describe the process by which we generate one sample path for an employment spell; for each individual in the sample we construct  $R$  such paths. If the minimum acceptable wage with each type of employer is the same, then the distribution of match draws in the first job spell is independent of the type of firm at which the individual finds employment. We simulate the match draw at the first firm by first drawing a value  $\zeta_1$  from a uniform distribution defined on  $[0, 1]$ , which we denote by  $U(0, 1)$ . The match draw itself comes from a truncated lognormal distribution with lower truncation point given by the common reservation wage  $\theta_\xi^*$ . We have

$$\theta_\xi(\zeta_1) = \exp\left(\mu + \sigma \Phi^{-1}\left(1 - \Phi\left(\frac{\ln(\theta_\xi^*) - \mu}{\sigma}\right)(1 - \zeta_1)\right)\right). \quad (20)$$

The rate of leaving the unemployment spell is  $h_\xi^u = \lambda \tilde{G}(\theta_\xi^*)$ , so the likelihood of the completed unemployment duration of  $t^u$  is

$$h_\xi^u \exp(-h_\xi^u t^u).^{14} \quad (21)$$

Given that the firm is a high cost firm, the wage and health insurance decision are given by

$$(w_\xi^2, d_\xi^2) = (\hat{w}_\xi, \hat{d}_\xi)(\theta_\xi(\zeta_1), \phi_2, V_\xi^N), \quad (22)$$

where the equilibrium values  $x_\xi^j$  denote the value of choice  $x$  at the beginning of job spell 1 given a firm type  $\phi_j$  and an individual type  $\xi$ , and  $\hat{x}_\xi$  denotes the equilibrium mapping from these state variables into the contract, where  $x = w, d$ . The critical value for leaving the first firm will be equal to  $\theta_\xi(\zeta_1)$  whenever another high cost employer is encountered, and otherwise is equal to  $\bar{\theta}_\xi(\theta_\xi(\zeta_1), \phi_2, \phi_1)$  when a low cost firm is met. The likelihood that the first job ends due to a quit of any kind is then

$$h_\xi^q(\zeta_1, \phi_2) = \lambda_e(\pi \tilde{G}(\theta_\xi(\zeta_1)) + (1 - \pi) \tilde{G}(\bar{\theta}_\xi(\theta_\xi(\zeta_1), \phi_2, \phi_1))). \quad (23)$$

Since the "total hazard" associated with the first job in the employment spell is simply the sum of the hazard associated with a voluntary quit and a involuntary one, we have

$$h_\xi^e(\zeta_1, \phi_2) = h_\xi^q(\zeta_1, \phi_2) + \eta_{d_\xi^2} \quad (24)$$

<sup>13</sup>In a stationary model such as this one, the distribution of forward recurrence times of length-biased spells (i.e., those in progress at the time the sample window begins) is the same as the population distribution of completed spells (that are not length-biased). In our case, both distributions are negative exponential with parameter  $h_\xi^u$ .

<sup>14</sup>Note that this density is the same whether the individual began the sample window in this spell or whether it began after the observation period had commenced.

When the first employer is a low cost firm the situation is symmetric. The equilibrium wage and health insurance decisions are given by

$$(w_\xi^1, d_\xi^1) = (\hat{w}_\xi, \hat{d}_\xi)(\theta_\xi(\zeta_1), \phi_1, V_\xi^N). \quad (25)$$

The critical value that will induce job acceptance at a competing low cost firm is  $\theta_\xi(\zeta_1)$ , while a higher match is in general required if the individual is to accept employment at a high cost firm. The rate of leaving this job for another employer is

$$h_\xi^q(\zeta_1, \phi_1) = \lambda_e(\pi \tilde{G}(\bar{\theta}_\xi(\theta_\xi(\zeta_1), \phi_1, \phi_2)) + (1 - \pi) \tilde{G}(\theta_\xi(\zeta_1))), \quad (26)$$

and the total rate of leaving this job is

$$h_\xi^e(\zeta_1, \phi_1) = h_\xi^q(\zeta_1, \phi_1) + \eta_{d_\xi^1}. \quad (27)$$

If the first job in the employment spell is still in progress at the end of the sample period then it is right-censored and we have all of the information required to compute the likelihood contribution. Conditioning on the individual's type for the moment, the likelihood value associated with this particular simulation is given by

$$\begin{aligned} L_\xi^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1 | \zeta_1, T) &= \omega_\xi(T) \times h_\xi^u \exp(-h_\xi^u t^u) \\ &\times \{ \pi f(\tilde{w}_1 | w_\xi^2) \times p(\tilde{d}_1 | d_\xi^2) \times \exp(-h_\xi^e(\theta_\xi(\zeta_1), \phi_2) t_1) \\ &\quad + (1 - \pi) f(\tilde{w}_1 | w_\xi^1) \times p(\tilde{d}_1 | d_\xi^1) \times \exp(-h_\xi^e(\theta_\xi(\zeta_1), \phi_1) t_1) \}, \end{aligned}$$

where  $c_1 = 1$  if the first job spell is right-censored and is equal to 0 if not. The density  $f(\tilde{w}_1 | w_1)$  is generated from the measurement error assumption, as is  $p(\tilde{d}_1 | d_1)$ . The term  $\exp(-h_\xi^e(\zeta_1, \phi) t_1)$  is the probability that the first job spell has not ended after a duration of  $t_1$  given that it is with a firm of type  $\phi$ .

To form the likelihood contribution for the individual we have to average over a large number of simulation draws and over the possible individual types. Since both averaging operations are linear operations it makes no difference in which order we perform them. Then define the likelihood contribution for an individual with observed characteristics  $(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1, T)$  by

$$\begin{aligned} L^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1 | T) &= R^{-1} \sum_{r=1}^R \{ \delta L_{\xi_2}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1 | \zeta_1(r), T) \\ &\quad + (1 - \delta) L_{\xi_1}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1 | \zeta_1(r), T) \}, \end{aligned} \quad (28)$$

where  $\zeta_1(r)$  is the  $r^{th}$  draw from the  $U(0, 1)$  distribution.

For the case in which the first job spell is complete and ends in an unemployment spell, the conditional likelihood function is slightly different. The likelihood that an individual of type  $\xi$  with a first job draw of  $\theta$  who is employed at a firm of type  $\phi$  exits into unemployment at time  $t_1$  is the density of durations into unemployment conditional on exiting into unemployment multiplied by the probability that the individual has not found a better job by time  $t_1$ . This is simply the survivor function associated with the ‘‘voluntary exits’’ density evaluated at  $t_1$ , so that the product of these two terms is

$$\begin{aligned} &\eta_{d_\xi^j} \exp(-\eta_{d_\xi^j} t_1) \times \exp(-h_\xi^q(\zeta_1, \phi_j) t_1) \\ &= \eta(d_\xi^j) \exp(-h_\xi^e(\zeta_1, \phi_j) t_1) \end{aligned} \quad (29)$$

when the first job spell was at a firm of type  $\phi_j$ . Then we have

$$\begin{aligned} L_\xi^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 0, \Psi = 1 | \zeta_1, T) &= \omega_\xi(T) \times h_\xi^u \exp(-h_\xi^u t^u) \\ &\times \{\pi f(\tilde{w}_1 | w_\xi^2) \times p(\tilde{d}_1 | d_\xi^2) \times \eta(d_\xi^2) \exp(-h_\xi^e(\zeta_1, \phi_2)t_1) \\ &+ (1 - \pi) f(\tilde{w}_1 | w_\xi^1) \times p(\tilde{d}_1 | d_\xi^1) \times \eta(d_\xi^1) \exp(-h_\xi^e(\zeta_1, \phi_1)t_1)\}, \end{aligned} \quad (30)$$

and the empirical likelihood contribution for this case is

$$\begin{aligned} L^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 0, \Psi = 1 | T) &= R^{-1} \sum_{m=1}^R \{\delta L_{\xi_2}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 0, \Psi = 1 | \zeta_1(r), T) \\ &+ (1 - \delta) L_{\xi_1}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 0, \Psi = 1 | \zeta_1(r), T)\}. \end{aligned} \quad (31)$$

### 4.3 Two or More Job Spells

When there exist two or more job spells we use only the information on the wage and health insurance status of the first two job spells as well as the duration of the first job in the employment spell. This simplifies our computational burden, and results in very little loss of information since only a small proportion of employment spells contain more than two jobs in our data.

To obtain the wage and health insurance associated with the second spell we proceed as follows. Conditional on the first job being with a high cost employer, for example, and given the first random draw of  $\theta_\xi(\zeta_1)$ , the individual has three ways to exit the first job spell. First, she may find employment with another high cost employer. The rate at which this occurs is  $\lambda_e \pi \tilde{G}(\theta_\xi(\zeta_1))$ . Second, she may find employment with a low cost employer, which occurs at rate  $\lambda_e (1 - \pi) \tilde{G}(\bar{\theta}_\xi(\theta_\xi(\zeta_1), \phi_2, \phi_1))$ . Third, she may exit the spell due to a forced termination, which occurs at rate  $\eta(d_\xi^2)$ . Then the likelihood that an individual of type  $\xi$  with match  $\theta_\xi(\zeta_1)$  at a high cost firm finds another high cost firm job at first job spell duration  $t_1$  is

$$\lambda_e \pi \tilde{G}(\theta_\xi(\zeta_1)) \exp(-h_\xi^e(\zeta_1, \phi_2)t_1), \quad (32)$$

while the likelihood that she will find a job with a low cost firm is

$$\lambda_e (1 - \pi) \tilde{G}(\bar{\theta}_\xi(\theta_\xi(\zeta_1), \phi_2, \phi_1)) \exp(-h_\xi^e(\zeta_1, \phi_2)t_1). \quad (33)$$

We draw a pseudo-random number  $\zeta_2$  from  $U(0, 1)$ . If the individual finds a job in a high cost firm, determine her match value as

$$\theta_\xi^{2,2}(\zeta_1, \zeta_2) = \exp(\mu + \sigma \Phi^{-1}(1 - \Phi(\frac{\ln(\theta_\xi(\zeta_1)) - \mu}{\sigma})(1 - \zeta_2))), \quad (34)$$

where  $\theta_\xi^{2,2}(\zeta_1, \zeta_2)$  is an acceptable match value at the second job given that both jobs are with type  $\phi_2$  employers (the first term in the superscript corresponds to the employer type at the first job and the second term is the employer type at the second job). Then the wage and health insurance status at the second job are given by

$$(w_\xi^{2,2}, d_\xi^{2,2}) = (\hat{w}_\xi, \hat{d}_\xi)(\theta_\xi^{2,2}(\zeta_1, \zeta_2), \phi_2, \theta_\xi(\zeta_1), \phi_2), \quad (35)$$

where the superscripts on the wage and health insurance outcomes denote the types of the firms in both periods.

If the individual finds a job in a low cost firm, define

$$\theta_{\xi}^{2,1}(\zeta_1, \zeta_2) = \exp(\mu + \sigma \Phi^{-1}(1 - \Phi(\frac{\ln(\bar{\theta}_{\xi}(\theta_{\xi}(\zeta_1), \phi_2, \phi_1)) - \mu}{\sigma})(1 - \zeta_2))), \quad (36)$$

so that the wage and health insurance outcomes for this case are

$$(w_{\xi}^{2,1}, d_{\xi}^{2,1}) = (\hat{w}_{\xi}, \hat{d}_{\xi})(\theta_{\xi}^{2,1}(\zeta_1, \zeta_2), \phi_1, \theta_{\xi}(\zeta_1), \phi_2). \quad (37)$$

Then the likelihood contribution for an individual whose first job was at a high cost firm with a match value of  $\theta_{\xi}(\zeta_1)$  and who spent a duration of  $t_1$  at that firm is given by

$$\begin{aligned} L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1, \zeta_2, \phi^{(1)} = \phi_2, T) &= \omega_{\xi}(T) \times h_{\xi}^u t^u \exp(-h_{\xi}^u t^u) \quad (38) \\ &\times \{\lambda_e \pi \tilde{G}(\theta_{\xi}(\zeta_1)) \exp(-h_{\xi}^e(\zeta_1, \phi_2) t_1) \times f(\tilde{w}_1 | w_{\xi}^2) \times f(\tilde{w}_2 | w_{\xi}^{2,2}) \\ &\times p(\tilde{d}_1 | d_{\xi}^2) \times p(\tilde{d}_2 | d_{\xi}^{2,2}) \\ &+ \lambda_e (1 - \pi) \tilde{G}(\bar{\theta}_{\xi}(\theta_{\xi}(\zeta_1), \phi_2, \phi_1)) \exp(-h_{\xi}^e(\zeta_1, \phi_2) t_1) \times f(\tilde{w}_1 | w_{\xi}^2) \times f(\tilde{w}_2 | w_{\xi}^{2,1}) \\ &\times p(\tilde{d}_1 | d_{\xi}^2) \times p(\tilde{d}_2 | d_{\xi}^{2,1})\} \end{aligned}$$

We construct an analogous term for the case in which the first job is with a low cost employer, namely

$$\begin{aligned} L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1, \zeta_2, \phi^{(1)} = \phi_1, T) &= \omega_{\xi}(T) \times h_{\xi}^u t^u \exp(-h_{\xi}^u t^u) \quad (39) \\ &\times \{\lambda_e \pi \tilde{G}(\bar{\theta}_{\xi}(\theta_{\xi}(\zeta_1), \phi_1, \phi_2)) \exp(-h_{\xi}^e(\zeta_1, \phi_1) t_1) \times f(\tilde{w}_1 | w_{\xi}^1) \times f(\tilde{w}_2 | w_{\xi}^{1,2}) \\ &\times p(\tilde{d}_1 | d_{\xi}^1) \times p(\tilde{d}_2 | d_{\xi}^{1,2}) \\ &+ \lambda_e (1 - \pi) \tilde{G}(\theta_{\xi}(\zeta_1)) \exp(-h_{\xi}^e(\zeta_1, \phi_1) t_1) \times f(\tilde{w}_1 | w_{\xi}^1) \times f(\tilde{w}_2 | w_{\xi}^{1,1}) \\ &\times p(\tilde{d}_1 | d_{\xi}^1) \times p(\tilde{d}_2 | d_{\xi}^{1,1})\}. \end{aligned}$$

The likelihood contribution for these particular draws of  $\zeta_1$  and  $\zeta_2$  for this type  $\xi$  individual is then

$$\begin{aligned} L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1, \zeta_2) &= \pi L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1, \zeta_2, \phi^{(1)} = \phi_2, T) \quad (40) \\ &+ (1 - \pi) L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1, \zeta_2, \phi^{(2)} = \phi_1, T) \end{aligned}$$

As was the case when there was only one job in the employment spell, the “unconditional” likelihood contribution is given by

$$\begin{aligned} L^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | T) &= R^{-1} \sum_{r=1}^R \{\delta L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1(r), \zeta_2(r)) \quad (41) \\ &+ (1 - \delta) L_{\xi}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1 | \zeta_1(r), \zeta_2(r))\}. \end{aligned}$$

#### 4.4 The Complete Likelihood

In forming the likelihood function contributions above, we have only used information from individuals who experienced unemployment at some point during the sample period (i.e., cases with  $\Psi = 1$ ). We will now derive the likelihood of this event.

Let us say that the individual is randomly sampled at time  $\tau$  and that his labor market experiences are observed until time  $\tau + T$ , where  $T$  is the length of the sampling window. Thus the

individual can experience (at least one) unemployment spell over the interval  $[\tau, \tau + T]$  in one of two distinct ways: (1) by being unemployed at time  $\tau$  or (2) by being employed at time  $\tau$  and exiting into unemployment prior to  $\tau + T$ .

We have already seen that under the stationarity assumptions of the model the hazard rate out of unemployment is  $h_\xi^u$ . Thus the mean duration of an unemployment spell for a type  $\xi$  individual is simply  $(h_\xi^u)^{-1}$ . A type  $\xi$  individual will utilize a set of decision rules adapted to his type, and will have a distribution of completed employment spell durations, which is the sum of consecutive job spells, that does not belong to the negative exponential family. The distribution will be a complicated function of all of the primitive parameters of the model, including the distribution of firm types  $\phi$ . While there does not exist an analytic expression for this distribution, it will be stationary and can be approximated to any arbitrary degree of accuracy using simulation methods. Let the distribution of completed employment spell lengths for a type  $\xi$  individual be given by  $F_\xi^e(t^e)$ , with the mean of the distribution denoted  $\mu_\xi^e$ .

The probability that a type  $\xi$  individual will be found in the unemployment state at a random sampling time  $\tau$  in the steady state is given by the ratio of the average length of an unemployment spell to the average length of a labor market cycle, or

$$p_\xi^u = \frac{(h_\xi^u)^{-1}}{(h_\xi^u)^{-1} + \mu_\xi^e}. \quad (42)$$

This represents the probability that the sampling window begins with an unemployment spell.

To compute the probability that an individual enters an unemployment spell given that he began the sampling window in the employment state it is necessary to proceed as follows. Assume that the individual is in an employment spell of length  $\tilde{t}$  when the sampling period begins. Then the probability that the employment spell will end before the completion of the sampling window is

$$\frac{F_\xi^e(\tilde{t} + T) - F_\xi^e(\tilde{t})}{1 - F_\xi^e(\tilde{t})}. \quad (43)$$

The distribution of on-going durations of an employment spell in progress at a randomly chosen date is well known to be given by

$$\frac{1 - F_\xi^e(\tilde{t})}{\mu_\xi^e}, \quad (44)$$

and the probability that the individual is employed at the sampling time is  $1 - p_\xi^u$ . Then the likelihood that an unemployment spell will start during the period  $[\tau, \tau + T]$  given that the individual was employed at time  $\tau$  is

$$\frac{F_\xi^e(\tilde{t} + T) - F_\xi^e(\tilde{t})}{\mu_\xi^e}. \quad (45)$$

Putting all of these elements together, we have that the probability that the individual will be in the unemployment state at some time during the randomly selected period  $[\tau, \tau + T]$  is

$$\begin{aligned} \omega_\xi(T) &= \frac{(h_\xi^u)^{-1}}{(h_\xi^u)^{-1} + \mu_\xi^e} \\ &+ \frac{\mu_\xi^e}{(h_\xi^u)^{-1} + \mu_\xi^e} \int_0^\infty \frac{F_\xi^e(\tilde{t} + T) - F_\xi^e(\tilde{t})}{\mu_\xi^e} d\tilde{t} \\ &= \frac{1}{(h_\xi^u)^{-1} + \mu_\xi^e} \left\{ (h_\xi^u)^{-1} + \int_0^\infty (F_\xi^e(\tilde{t} + T) - F_\xi^e(\tilde{t})) d\tilde{t} \right\}. \end{aligned} \quad (46)$$

Note that

$$\begin{aligned}
\lim_{T \rightarrow \infty} \omega_\xi(T) &= \frac{1}{(h_\xi^u)^{-1} + \mu_\xi^e} \left\{ (h_\xi^u)^{-1} + \lim_{T \rightarrow \infty} \int_0^\infty (F_\xi^e(\tilde{t} + T) - F_\xi^e(\tilde{t})) d\tilde{t} \right\} \\
&= \frac{1}{(h_\xi^u)^{-1} + \mu_\xi^e} \left\{ (h_\xi^u)^{-1} + \int_0^\infty (1 - F_\xi^e(\tilde{t})) d\tilde{t} \right\} \\
&= 1 \quad \forall \xi.
\end{aligned} \tag{47}$$

This last result demonstrates that all nonrandomness in our subsample of individuals who experience an unemployment spell at some point in the observation period is attributable to the finiteness of the sampling window (given our assumption that the original sample to which we have access is randomly drawn). As the sampling window grows indefinitely large the model implies that the set of original sample members excluded by our unemployment spell requirement is of measure 0 so that nonrandom sampling problems are precluded.

The final specification of the likelihood function can now be derived. We have already specified the likelihood contributions for the individuals for whom  $\Psi = 1$ . For those individuals who do not experience an employment spell we only utilize the information that  $\Psi = 0$ . This probability is given by

$$p(\Psi = 0|T) = \delta(1 - \omega_{\xi_2}(T)) + (1 - \delta)(1 - \omega_{\xi_1}(T)). \tag{48}$$

Let the set of individuals who were unemployed at some time in the sample period and who contribute only a right-censored unemployment spell to the likelihood (our Case 1 above) be given by  $\Upsilon_1$ , the set of individuals with an unemployment spell followed by one job spell be given by  $\Upsilon_2$ , and the set of individuals with unemployment and two consecutive job spells be denoted by  $\Upsilon_3$ . Let the set containing the remaining individuals, those who experienced no unemployment during their sample observation periods, be denoted  $\Upsilon_4$ . Then the likelihood of the sample is given by

$$\begin{aligned}
L &= \prod_{i \in \Upsilon_1} L^{(1)}(t_i^u, \Psi_i = 1|T_i) \prod_{i \in \Upsilon_2} L^{(2)}(t_i^u, \tilde{w}_{1,i}, \tilde{d}_{1,i}, t_{1,i}, c_{1,i}, \Psi_i = 1|T_i) \\
&\times \prod_{i \in \Upsilon_3} L^{(3)}(t_i^u, \tilde{w}_{1,i}, \tilde{d}_{1,i}, t_{1,i}, \tilde{w}_{2,i}, \tilde{d}_{2,i}, \Psi_i = 1|T_i) \prod_{i \in \Upsilon_4} p(\Psi_i = 0|T_i).
\end{aligned} \tag{49}$$

Maximization of the log of this function with respect to the primitive parameters of the model yields estimators with desirable asymptotic properties as long as the number of simulations  $R$  is growing at an appropriate rate with respect to the sample size. In our implementation we have set  $R = 1000$  and have located the maximum likelihood estimators through the use of a simplex algorithm. To compute the standard errors of the estimates we have utilized bootstrap methods. We found the bootstrap approach attractive due to the discontinuities in the numerical likelihood that arose from the use of simulated match draws and due to the nature of the approximations used in solving the decision rules (see Appendix C). Although solving the model is computer intensive, it was feasible to reestimate each of the four specifications reported below 50 times each, and our bootstrap estimates of the standard errors are based on these replications.

## 4.5 Identification Issues

While our goal is to estimate all of the primitive parameters of the model, from Flinn and Heckman (1982) we know that the search model (with or without bargaining) is fundamentally underidentified using the type of data to which we have access. They show that the pair of parameters  $(\rho, b)$  are not individually identified; as is common in the literature, our response is to fix the discount rate at a given value. We have chosen an annualized rate of 0.08.



Those authors also show that when only accepted job information is available, identification of  $G$  requires that functional form assumptions be made. We assume that the productivity distribution  $G(\theta)$  is lognormal with parameters  $\mu_\theta$  and  $\sigma_\theta$ . Furthermore, we assume that the measurement error distribution is lognormal with parameters  $\mu_\varepsilon = 0$  and  $\sigma_\varepsilon > 0$ .<sup>15</sup> These types of functional form assumptions are relatively standard in the literature (see, e.g., Flinn (2002)).

Given a value of the bargaining power parameter,  $\alpha$ , identification of the other primitive parameters is relatively standard. It is exceedingly difficult to attain credible estimates of  $\alpha$  given access to only supply side information. This problem is discussed in Eckstein and Wolpin (1995), and an extensive analysis of the issue in a context similar to the one considered in this paper is contained in Flinn (2003). He shows that the parameter  $\alpha$  can be identified using only supply side information (i.e., wage and duration information from survey respondents) if the matching distribution has a known scale parameter. This is unlikely to be the case in most applications, and is certainly not the case here since we are attempting to estimate the unknown scale parameter  $\mu$  of the log normal distribution.

Instead we adopt the strategy of Flinn (2003) to estimate  $\alpha$ . By using a piece of aggregate information on the ratio of labor compensation to total revenues, we can effectively reduce the dimension of the parameter space by one and achieve credible (i.e., precise) estimates of  $\alpha$ . Heuristically speaking, such a piece of information serves to fix the total size of the “pie” to be divided, or the scale of the matching distribution. In our application, the procedure is implemented as follows. We begin by defining total revenues in the steady state to a type  $\phi_j$  firm from type  $\xi_i$  employees as

$$R_{SS}(i, j) = \int_{\theta_i^*} \theta dG_{SS}(\theta|i, j). \quad (50)$$

Let the steady state distribution of  $\theta$  and  $\xi$  within the employed population be given by  $\omega(i, j)$ , where  $\omega(1, 1) + \omega(1, 2) + \omega(2, 1) + \omega(2, 2) = 1$ . The steady state revenues are given by

$$R_{SS} = \sum_{i, j} \omega(i, j) R_{SS}(i, j). \quad (51)$$

Average steady state compensation of a type  $\xi_i$  individual at a type  $\phi_j$  firm is given by

$$C_{SS}(i, j) = \int_{\theta_i^*} w^*(\theta', \theta|i, j) G_{SS}(\theta', \theta|i, j) + \phi_j \tilde{G}_{SS}(\theta_{i, j}^{**}, \infty|i, j), \quad (52)$$

where the function  $w^*(\theta', \theta|i, j)$  is the equilibrium mapping from the best match  $\theta'$  and dominated match  $\theta$  into the wage for a type  $\xi_i$  individual at a type  $\phi_j$  firm. Then average steady state compensation is given by

$$C_{SS} = \sum_{i, j} \omega(i, j) C_{SS}(i, j). \quad (53)$$

The steady state labor share of total revenues is then simply

$$\Gamma_{SS} = \frac{C_{SS}}{R_{SS}}. \quad (54)$$

Partition the vector of model parameters into  $(\alpha, \Theta)$ , and write the steady state labor share in the environment  $(\alpha, \Theta)$  as  $\Gamma_{SS}(\alpha, \Theta)$ . Flinn (2003) shows that  $\Gamma_{SS}$  is monotonically increasing in its first argument for all values of  $\Theta$ . Then the estimation strategy is to condition on a value of

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<sup>15</sup>Thus the log wage has a measurement error with mean 0, but the mean measurement error in levels is  $\exp(\sigma_\varepsilon^2/2)$ .

$\alpha$  and maximize the log likelihood over  $\Theta$ . Denote this conditional maximum likelihood estimator by  $\hat{\Theta}(\alpha)$ . If the observed value of labor share is  $\Gamma_0$ , then the maximum likelihood estimator of the model is

$$\Gamma_0 = \Gamma_{SS}(\hat{\alpha}, \hat{\Theta}(\hat{\alpha})). \quad (55)$$

If  $\hat{\Theta}(\alpha)$  is unique for all  $\alpha$ , then  $(\hat{\alpha}, \hat{\Theta}(\hat{\alpha}))$  is unique as well.

Since [55] is a significant piece of information in determining the parameter estimates, and since the observed value of  $\Gamma_0$  is treated as “truth,” it is important to use a reasonable value for  $\Gamma_0$  in obtaining the maximum likelihood estimates. We have based our estimates on statistics reported in Krueger (1999). For the year 1998, which is the “modal” year of our sample, the only computed labor share value available is 0.766. Given that our sample only includes prime-age white males, we felt that it would be appropriate to adjust the share upward and settled on a value of 0.81. While model estimates, particularly of the bargaining power parameter  $\alpha$ , are quite sensitive to the labor share value used in the estimation, the substantive implications of our results are not. This is explained in more detail in the next section in the course of discussing the empirical results.

## 5 Empirical Results

We begin by reporting and discussing estimates from two specifications of the model.<sup>16</sup> The initial specification assumes homogeneity on both sides of the market. The second specification allows firm heterogeneity (i.e.,  $\phi_1 \neq \phi_2$ ) only. The third specification considers both worker (i.e.,  $\xi_2 \neq \xi_1$ ) and firm heterogeneity, but restricts the probability that an individual has a high demand of health insurance to be independent of observable characteristics. The second specification allows both worker and firm heterogeneity, and allows for the probability that the worker is a high demand type to depend on observable characteristics in the following manner:

$$\delta(Z) = \frac{\exp(\delta_0 + \delta_1 Z_1 + \delta_2 Z_2)}{1 + \exp(\delta_0 + \delta_1 Z_1 + \delta_2 Z_2)} \quad (56)$$

where  $Z_1$  is an indicator variable that takes the value 1 when the sample member is married and  $Z_2$  is an indicator variable that takes the value 1 if he has children. Since it is somewhat difficult to directly interpret some of the primitive parameters, we also compute estimates of a number of the moments of the distributions of labor market outcomes, both in the steady state and outside of it.

Table 2 presents the simulated maximum likelihood estimates for two specifications of the model. The first two columns correspond to the “fully” estimated model, i.e., the one in which the bargaining power parameter is estimated along with the other (estimable) primitive parameters. Columns three and four contain estimates of the symmetric Nash bargaining model; in this case the bargaining power parameter is not estimated and is fixed at the value 0.5. We will discuss both cases, but will focus most of our discussion on the first two columns of estimates. By comparing the estimates in the first two columns with those in the last two, we will be able to isolate those parameters that our most sensitive to variations in  $\alpha$ .

The parameter  $\alpha$  is actually only estimated for the first specification, in which there is no firm or worker heterogeneity. In this case, we employed the procedure discussed in Section 4.5 to obtain  $\hat{\alpha} = 0.25$ . Due to the lack of smoothness in the log likelihood, particularly where  $\alpha$  was concerned, we did not attempt to determine a standard error for  $\hat{\alpha}$ . In terms of the statistical properties of the

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<sup>16</sup>We estimated two other specifications in which we allowed for heterogeneity on one side of the market while imposing homogeneity on the other. We found little differences in the estimates from these (omitted) specifications and the first (that posits homogeneity on both sides of the market) and to conserve space we have omitted them.

estimates reported, all standard errors associated with other model parameters are only consistent under the assumption that  $\alpha$  actually equals 0.25 (or 0.5) in the population. The reason why we did not attempt to estimate  $\alpha$  for the second specification is that firm revenue information is not available for individual worker- or firm-types, particularly since the firm types are assumed to be unobservable to us in the SIPP data. While one could restrict the labor shares for each firm-worker pairing to be equal to the aggregate share, there is no theoretical basis for doing so. Furthermore, Flinn (2003) finds that imposing such a restriction results in group-specific estimates of  $\alpha$  that are relatively tightly clustered around the “aggregate” estimate. On the basis of this evidence, we don’t believe that fixing the value of  $\alpha$  at 0.25 throughout all of the specifications will affect the empirical results to any significant degree.

For ease of exposition we will distinguish three subsets of the primitive parameters in addition to  $\alpha$ : (1) those parameters which are constant across specifications (i.e., the job offer arrival rates,  $\lambda_n$  and  $\lambda_e$ , the job dissolution rates,  $\eta_1$  and  $\eta_0$ , the parameters characterizing the productivity distribution,  $\mu_\theta$  and  $\sigma_\theta$ , the parameters that define the measurement error processes,  $\sigma_\varepsilon$  and  $\gamma$ , and the unemployment utility flow,  $b$ ); (2) parameters that characterize the distribution of health insurance costs (i.e.,  $\phi_1$ ,  $\phi_2$ , and  $\pi$ ); and (3) parameters that define the distribution of private demands for health insurance (i.e.,  $\xi_2$ ,  $\delta_0$ ,  $\delta_1$ ,  $\delta_2$ ). We will begin our discussion with the first set of parameters. For ease of presentation, the rate parameter estimates in Table 2 have all been multiplied by 100.

Perhaps the most important finding in Table 2 is that our estimates strongly support the premise of our model that  $\eta_0 > \eta_1$ .<sup>17</sup> Durations are measured in weeks, so that our estimates imply that, on average, a job without health insurance will exogenously dissolve after approximately one and a half years, while a job with insurance will dissolve after twelve years. The point estimate of  $\lambda_n$ , 0.070, implies that the mean wait between contacts (when unemployed) is 3.25 months. In contrast, the point estimate of  $\lambda_e$ , 0.012, suggests that a contact between a new potential employer and a currently employed individual occurs about every 19 months. The standard error of the estimate of  $\lambda_e$  is sufficiently small that it is safe to say that employed search is an important source of turnover, something which is obvious from the raw data as well.

As was discussed in the previous section, for the model to fit the data requires that measurement error be incorporated. In some sense, the degree of measurement error required to provide an acceptable degree of fit of the equilibrium model to the data can be considered an index of the degree of model misspecification. The estimate of the standard deviation of the logarithm of the measurement error in log wage rates,  $\sigma_\varepsilon$ , takes a value similar to that found in most similar studies. More interesting perhaps is the estimated amount of error in the measurement of health insurance coverage. The estimate of  $\gamma$  is found to be about 0.87, so that, in conjunction with the measurement error assumed to be present in wage rates, the probability of mismeasurement of health insurance status is approximately 13 percent.

Turning to the estimates of the parameters characterizing the distribution of health insurance costs, we find important similarities across the two model specifications. In the initial specification, in which all firms face the same cost, the point estimate of the cost of insurance is \$5.83 per hour. On the face of it, this estimate may appear high, but compared to the mean wage of insured jobs in the steady state (simulated to be a little over \$20 per hour), we find that health insurance accounts for slightly more than 22 percent of total employer costs. When we allow for covariates in the probability that an individual is a high-demand type as well as heterogeneity in the cost of insurance to firms, the difference in the costs of insurance is estimated to be \$1.33, which is a

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<sup>17</sup>In our parameterization of the model, the log likelihood would still be well-defined even if the ordering of the estimated exogenous separation rates was not consistent with our assumption. The “incongruity,” if you will, would be seen in an estimated value of the cost of insurance that was negative.

considerable difference, although the proportion of high cost firms is only 0.03. As a consequence of these features of the estimated cost distribution, it seems fair to say that there is no strong indication of firm heterogeneity in  $\phi$ . This result is mainly responsible for the small amounts of “job lock” reported in the next below.

The second specification allows for a “private” demand for health insurance, and posits that individuals with different observable characteristics will have different probabilities of being a high demand type. We find that the direct payoff to having health insurance for private demanders is a relatively modest 66 cents per hour. There are large differences in the likelihood of being in the high-demand group across observable types. The estimated relationship between observable characteristics and the likelihood of having a private demand for health insurance is consistent with conventional wisdom. An unmarried individual without children has only a probability of 0.13 of being a high demand type, while a married man without children has a probability of 0.43 of being a high-demand type. A married man with children has a probability of 0.560 of having a private demand for insurance. We find that, given the sample composition by household type, the average probability of being a high demand type is 0.379.

The primitive parameters are often difficult to interpret, so in Tables 3, 4, and 5 we provide some more easily interpreted statistics computed under the estimated equilibria associated with the two specifications (for the two values of  $\alpha$  upon which we focus). We present the implied critical matches for transitions out of unemployment,  $\theta_{\xi}^*$ , and for the provision of health insurance,  $\theta_{\xi}^{**}(\phi)$ , in Table 3. We also compute the probability that a match is acceptable and the probability that an acceptable match results in the provision of health insurance. In addition, we estimate the mean unemployment spell duration and the probability that an individual of a given type is unemployed over the length of the sample window. Beginning with our baseline specification with no heterogeneity, we find that nearly 89 percent of all potential matches are accepted out of unemployment and that nearly 44 percent of these matches result in the provision of health insurance. The mean unemployment duration is close to 18 weeks and nearly 27 percent of the population would be observed in the unemployment state sometime during the sample window. Moving to the second specification, we find relatively small differences in the labor market outcomes of high- and low-demand workers and high- and low-cost firms. Specifically, we find that low-demand individuals accept 80 percent of matches out of the unemployment state, whereas 78 percent of matches are accepted by high-demand workers. As a result, the mean unemployment duration is only about one-third of a week different for the two types of workers. We do see larger differences in the probability that an acceptable worker-firm match results in the provision of health insurance across worker and firm types. A high-demand worker will have health insurance at 44 percent of low-cost firms, but will gain coverage at only 33 percent of high-cost firms. On the other hand, low-demand workers will be insured at 39 percent of low-cost firms and 29 percent of high-cost firms. We estimate that low-demand individuals are slightly more likely than high-demand workers, by 27.3 to 26.3 percent, to be observed in the unemployment state over the sample window.

Table 4 presents some summary statistics for characteristics of the first job directly following an unemployment spell. Since the theoretical predictions of the model (in terms of equilibrium wages and job spell durations) are clearest following an unemployment spell and since most of our wage and health insurance data come from the first job following such a spell, these estimates provide a useful comparison between the theoretical (estimated) predictions of the model and the data. The results from the first specification indicates that 44 percent of first jobs provide health insurance, that the mean wage in jobs with health insurance is 42 percent higher than the mean wage in jobs without insurance, and that (first) jobs with health insurance tend to last about six times longer than jobs without health insurance. The estimates from the second specification point to some important features of the model. First, we find that almost 43 percent of high-demand individuals

have health insurance coverage and 38 percent of low-demand workers have coverage in the first job following an unemployment spell. Second, we see that low demand workers actually earn 66 cents per hour more, on average, than high demand workers at jobs with insurance coverage. This is not only due to the direct effect of the private demand on the wages, as captured by  $\xi_2$ , but also because high-demand workers have health insurance coverage at relatively less productive matches than do low-demand workers. Third, we see that high-demand workers earn slightly more than low-demand workers at jobs without insurance, which is solely due to a composition effect.<sup>18</sup> Lastly, we find that low-demand workers have longer job durations at insured jobs than high demand workers. While this result may seem paradoxical, recall that high-demand individuals have health insurance at relatively less productive matches. Thus voluntary turnover from jobs covered by health insurance will occur at higher rates in the high-demand population than in the low demand population, while the involuntary separation rate is the same for the two groups ( $\eta_1$ ).

The model does do a reasonably good job of fitting the conditional wage distributions observed in the data, as Figures 5.a and 5.b demonstrate.<sup>19</sup> The figures plot the theoretical (estimated) densities of the first wage observed after an unemployment spell conditional on health insurance status against the corresponding histogram of sample wage rates. Clearly the implications of the model are less satisfactory for the wage distribution associated with jobs without health insurance. While it is true that allowing for measurement error in wages acts to smooth away differences between the predictions of the equilibrium model and the data, the measurement error assumptions are restrictive enough that its presence cannot be the sole explanation of the high degree of correspondence between the predicted and observed distributions.

Table 5 presents some summary measures of the labor market in the steady state. The estimates are computed by simulating the labor market histories of one million individuals (of each type), who begin their labor market careers in the unemployment state, based on the parameter estimates from the two specifications. Because the implications from both specifications are similar, we will discuss only those from the second specification (column 2). The most striking feature is the lack of large differences between the steady state outcomes of low- and high-demand individuals. This is a result of the small size of the estimate of the utility parameter  $\xi_2$ . We see that the steady state unemployment rates of the two types are almost identical, as is steady state health insurance coverage. It is of interest to compare the rate of coverage in the steady state, about 87 percent for each group, with the rate of coverage in first jobs after an unemployment spell, which differed for the two groups but was centered at 40 percent. The steady state rate, which is roughly consistent with the observed rate of employer-provided health insurance coverage in this population, is produced by the systematic difference between the steady state distribution of job match values and the population distribution of these values. The former first-order stochastically dominates the later, thus producing the large differences in insurance coverage and wage rates observed in Tables 4 and 5.

In the bottom two panels of Table 5 we note the large differences between the wages associated with jobs with insurance and without insurance in the steady state. There are small differences between the average wage on jobs without health insurance in the steady state and immediately following unemployment due to the fact that the upper bound on match values is the same for both distributions and there is little difference in the distribution of match values below this critical value in the steady state and in the population. On the other hand, there are large differences between distributions of matches in the steady state and population when conditioning on health insurance provision. This is reflected in the large differences between the mean wage in covered jobs in the

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<sup>18</sup>This is due to the fact that low-demand individuals have a lower reservation match value into jobs without health insurance.

<sup>19</sup>We decided not to implement formal tests of model fit due to the large amount of censoring in the duration data.

steady state, over \$20 for both demand types, and in the first job following unemployment, a bit over \$11 for each demand type.

We now consider the implications of the estimates for degree of inefficiency in mobility decisions. Proposition 1 established that, in a model with differential costs of health insurance coverage (within the population of firms) and differential rates of private demand for health insurance (within the population of searchers), job mobility decisions are *conditionally* efficient. Thus, given a cost of health insurance  $c$  ( $= \phi - \xi$ ) associated with a match of productive value  $\theta$  and given a cost  $c'$  ( $= \phi' - \xi$ ) associated with a match of productive value  $\theta'$ , the worker will opt for the job in which the total surplus of the match is greatest. If we let the total surplus of the match be denoted by  $Q(\theta, c)$ , then efficient mobility implies

$$(\theta', c') \succ (\theta, c) \Leftrightarrow Q(\theta', c') > Q(\theta, c) \quad (57)$$

The total surplus of the match,  $Q(\theta, c)$ , is a strictly increasing function of  $\theta$  and nonincreasing function of  $c$ . This implies the possibility of an efficient choice of a job  $(\theta', c')$  over a job  $(\theta, c)$  when  $\theta' < \theta$ . However, in this eventuality it must be the case that  $c'$  is strictly less than  $c$ , or more formally

$$\begin{aligned} (\theta', c') &\succ (\theta, c) \text{ and } \theta' < \theta \\ &\Rightarrow c' < c \\ &\Rightarrow \phi' < \phi \end{aligned} \quad (58)$$

when we look at job movements for the same individual, where the last line in [58] follows from the fact that the individual component of costs ( $\xi$ ) is the same at both jobs.

From [58] it follows that if the cost of the provision of health insurance is the same at all firms, then

$$(\theta', c) \succ (\theta, c) \Leftrightarrow \theta' > \theta \quad (59)$$

when evaluated at the common  $\phi$  shared by all firms. Thus a degenerate distribution of  $\phi$  implies that all mobility choices are efficient in the sense of maximizing the instantaneous gross product of the match. The claim that differential health insurance costs distort otherwise efficient mobility decision seems to best be interpreted as a claim that selection of the largest  $\theta$  value is not ensured. We have shown that with differential costs of health insurance, selection of the largest  $\theta$  value is, in fact, not necessarily efficient. In this section we define and compute measures of “inefficiency,” by which we mean the probability of the choice of the smallest of the two values of  $\theta$  available to a currently employed searcher. The quotation marks in the previous sentence and in the title of this subsection refer to the fact that such choices are not, in fact, inefficient in the presence of firm heterogeneity in the cost of providing health insurance.<sup>20</sup> Nonetheless, it seems of interest to know the extent to which firm heterogeneity in  $\phi$  results in the choice of jobs with smaller values of  $\theta$ . The measures defined below compute the probability of such an event occurring when an employed searcher meets a new potential employer. Since these events can only occur when  $\phi$  is heterogeneous, we compute our measures for the model specifications that allow for this possibility (columns 2 and 4 of Table 2).

In computing the indices we use as a baseline the steady state joint distribution of  $(\theta, \xi, \phi)$  as a starting point.<sup>21</sup> Although in the population these characteristics are assumed to be independently

<sup>20</sup>In the remainder of this section we will not highlight the fact that the term inefficient mobility is actually a misnomer, but instead will use it as simply indicating the choice of a job opportunity with a lower match value.

<sup>21</sup>Since specification 2 does not include heterogeneity in searchers’ private demands for health insurance the steady state distribution is defined over  $(\theta, \phi)$  only.

distributed, systematic sorting will produce some dependence in the steady state distribution. Since there is no analytic solution for the joint steady state distribution of these characteristics, this distribution is approximated using simulation methods. We denote this joint distribution by  $p_{SS}(\theta, \xi, \phi)$ .

Next we use the decision rules described in Section 2 to write a critical match value required to induce mobility from a job at a potential employer of type  $\phi'$ . Define this critical match value as  $\bar{\theta}_\xi(\theta, \phi, \phi')$ . Thus any potential employer of type  $(\theta', \phi')$  will successfully recruit the individual if and only if  $\theta' > \bar{\theta}_\xi(\theta, \phi, \phi')$ . Using this function, the conditional probability of a job-to-job change given a contact with another firm is

$$\tilde{G}(\bar{\theta}_\xi(\theta, \phi, \phi'))p(\phi'),$$

where  $p(\phi')$  is the population proportion of type  $\phi'$  firms.

Only a proportion of all moves will be inefficient in the sense of involving the choice of a job with a lower  $\theta$  than that available at an alternative match. In the empirical literature on health insurance and mobility decisions a distinction is made between the case in which one *stays* at a firm with a lower  $\theta$  than that an alternative firm, termed “job lock,” and the situation in which an individual *moves* to a firm with a lower  $\theta$  value, termed “job push.” While the difference between the two is somewhat semantic, we can decompose the probability of an inefficient choice into these two sources using the following metric.

For an inefficient move to occur requires that the two firms currently competing for the searcher’s services be of different types. For there to exist “job push” requires that the current employer be type  $\phi_2$  and the potential employer be of type  $\phi_1$ . In the case of job push the critical value for leaving a match of  $\theta$  is less than or equal to  $\theta$ . The conditional probability that a move will be inefficient and be attributable to “job push” is then

$$\begin{aligned} p_{SS}(I_{JP}) &= \int_0^\infty \sum_{\xi \in \{\xi_1, \xi_2\}} \frac{[\tilde{G}(\bar{\theta}_\xi(\theta, \phi_2, \phi_1)) - \tilde{G}(\theta)]}{\tilde{G}(\bar{\theta}_\xi(\theta, \phi_2, \phi_1))} p(\phi_1) p_{SS}(\theta, \xi, \phi_2) d\theta \\ &> 0 \Leftrightarrow \phi_2 > \phi_1. \end{aligned} \quad (60)$$

For “job lock” to occur requires that the current employer be a low cost type and the potential employer be a high cost type. The critical match value in this case is greater than or equal to  $\theta$ , and the probability of inefficient mobility attributable to job lock is

$$\begin{aligned} p_{SS}(I_{JL}) &= \int_0^\infty \sum_{\xi \in \{\xi_1, \xi_2\}} \frac{[\tilde{G}(\theta) - \tilde{G}(\bar{\theta}_\xi(\theta, \phi_1, \phi_2))]}{\tilde{G}(\theta)} p(\phi_2) p_{SS}(\theta, \xi, \phi_1) d\theta \\ &> 0 \Leftrightarrow \phi_2 > \phi_1. \end{aligned} \quad (61)$$

The likelihood of inefficient mobility is simply the sum of these two probabilities, or

$$p_{SS}(I_T) = p_{SS}(I_{JP}) + p_{SS}(I_{JL}). \quad (62)$$

Before discussing the estimates of the degree of inefficient mobility, we show that whenever the firms competing for an individual’s labor services are of different cost types, the likelihood of passing on the higher match value is not negligible. If Figure 6 we have plotted the probability of “inefficient” mobility for low demand individuals using the estimates from the fourth column of Table 2.<sup>22</sup> Figure 6.a illustrates the probability of moving to a lower match value conditional on

<sup>22</sup>The probability of inefficient mobility function for high demand individuals is very similar. We have not plotted their conditional probability function so as to avoid clutter.

the searcher’s current match value at a high cost employer. Once  $\theta$  reaches the critical value at which health insurance would have been purchased at the employee’s current (high-cost) employer, the conditional probability of leaving for a lower value of  $\theta$  jumps to a bit less than 0.25, rising and then declining slowly thereafter. In Figure 6.b we have plotted the corresponding conditional probability function for the case of job lock, in which the current firm is a low-cost provider and the potential employer is high cost. We see a similar pattern as in Figure 6.a. Roughly speaking, the probability that the employee will pass up an opportunity possessing a higher value of  $\theta$  is approximately 0.23 over a large range of values of  $\theta$ .

While the “job lock” and “job push” phenomenon are not negligible *conditional* on firms of different cost types meeting, from our estimates of the distribution of  $\phi$  we know that this event occurs very infrequently. From column 2 of Table 2, the point estimate of the probability that an employee of a high-cost firm meets a low cost firm is 0.961. However, the steady state (unconditional) probability that an employer is high-cost is only 0.059, so that the probability of such a comparison in the steady state is only 0.055. The probability of an employee of a low-cost firm meeting a high-cost potential employer is approximately equal, so that the total probability of these events is about 0.110. The infrequency of these types of meetings accounts for the extremely low levels of “inefficient” mobility choices we observe.

Table 6 contains the estimates of the for the three model specifications estimated that include firm heterogeneity in  $\phi$  and for the two values of  $\alpha$  upon which we focus. The amounts of inefficient turnover are miniscule in all six columns of the table. The maximum total amount of inefficient turnover for  $\alpha = 0.25$  was about 1 percent (column 3), and “job lock” accounted for slightly more of the inefficient turnover than “job push.” The breakdowns were virtually identical when we distinguish between high- and low-private demand type searchers. Inefficient turnover was slightly more prevalent under the symmetric Nash bargaining assumption ( $\alpha = 0.5$ ), where the largest estimated value of total inefficient turnover is 2.37 percent. Even in this case, it is difficult to argue that the heterogeneity in firm health care costs produced significant amounts of ‘bad’ turnover decisions defined by the choice of the smallest  $\theta$  value in the employee’s choice set.

## 6 Conclusion

Researchers investigating the relationship between employer-provided health insurance, wages, and turnover have uncovered a number of empirical findings, not all of which are mutually consistent, that to date have not been explicable within an estimable dynamic model of labor market equilibrium. We propose such a model and show that it has implications for labor market careers broadly consistent with empirical evidence. Using SIPP data we estimate the model and, for the most part, obtain plausible results. The model is able to capture some of the most salient features of the event history data. In particular, our model is based on the premise that health insurance reduces the rate of arrival of negative health shocks that lead to job separations into the nonemployment state. In the data we find this prediction to be overwhelmingly supported. Furthermore, the model offers a cogent rationale for the necessity of conditioning on health insurance status as well as the wage rate when estimating job-separation hazards, and predicts that voluntary as well as non-voluntary separations will be lower for those with employer-provided health insurance than for those without it. The wage distributions associated with the jobs covered by health insurance and those not covered are also broadly consistent with the predictions of the model. No undue reliance on measurement error is required to make this relatively involved dynamic model consistent with the data.

We view one of the accomplishments of this paper as demonstrating theoretically and empiri-



cally that what may appear to be “job lock” is consistent with an equilibrium model in which all turnover is efficient. The model estimated here is innovative on at least two dimensions. First, we have estimated an equilibrium model in which jobs are (endogenously) differentiated along two dimensions: wages and health insurance provision. Second, the model allows for wage renegotiations with the employee’s current firm. While empirical implementations of matching models (e.g., Miller, 1984; Flinn, 1986) are consistent with wage changes during an employment spell, they imply no dependence between the wages paid at successive employers. The bargaining models formulated and estimated here and in Postel-Vinay and Robin (2000) and Cahuc et al. (2003) offer a more complete view of wage dynamics than other search-based models that are currently available.

To assess the quantitative significance of incomplete health insurance coverage for “inefficient” mobility outcomes, we introduced time-invariant heterogeneity within the population of firms and searchers. We showed that (time-invariant) worker differences in private demand for health insurance could not produce situations in which lower match values were preferred to higher ones; rather, firm heterogeneity in the costs of providing insurance was crucial. Our estimate of the distribution of firm costs implied that the distribution was almost degenerate. As a result, our measures of the degree to which employees pass on match-improving opportunities indicate that less than 3 percent of mobility decisions exhibit this property. Furthermore, it must be remembered that in the presence of firm heterogeneity in the costs of providing health insurance, all mobility decisions are efficient whether or not they involve the choice of an option with a lower match value than the alternative.

The model we have estimated and evaluated allows for rich forms of heterogeneity that are match-specific, firm-specific, and worker-specific. Nevertheless, it may be objected that all sources of heterogeneity are assumed to be time-invariant, and thus that the model fails to capture the impact of changing patterns of employee health insurance demand on mobility decisions. The argument usually put forth is that employees covered by health insurance and who experience an increase in their demand for health insurance face a wedge in the price of health insurance offered by their current employer and that which would be offered by any future potential employer. These price differences are the forces behind the phenomenon of “job lock,” though the existence of such a wedge clearly requires an assumption of no renegotiation of employment contracts when employee or employer characteristics change. Since such renegotiation is the foundation of our model, and for reasons of model tractability and the identification of model parameters, we have neglected time-varying heterogeneity in the current analysis. If this type of heterogeneity were to be introduced into a fully-articulated model of the labor market, an explicit rationale for precluding the renegotiation of labor market contracts would have to be added as well.

## A Proof of Proposition 1

**Proof:** Define the total surplus of the match as

$$\begin{aligned}
T_\xi(w, d; \theta, \phi) &= V_\xi^E(w, d; \theta, \phi) + V_\xi^F(w, d; \theta, \phi) \\
&= [\rho + \eta_d + \lambda_e \int_{\Phi} \tilde{G}(\hat{\theta}_\xi(w, d, \tilde{\phi})) dF(\tilde{\phi})]^{-1} \\
&\quad \times \{ \theta - (\phi - \xi)d + \eta_d V_\xi^N \\
&\quad + \lambda_e \int_{\Phi} \int_{\hat{\theta}_\xi(w, d, \tilde{\phi})}^{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{T}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}) dG(\tilde{\theta}) dF(\tilde{\phi}) \\
&\quad + \lambda_e \int_{\Phi} \int_{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, \theta, \phi) dG(\tilde{\theta}) dF(\tilde{\phi}) \}.
\end{aligned} \tag{63}$$

where  $\hat{T}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}) = T_\xi(\hat{w}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}), \hat{d}_\xi(\theta, \phi, \tilde{\theta}, \tilde{\phi}); \theta, \phi)$  is the equilibrium total surplus of the match  $(\theta, \phi)$  when a type  $\xi$  individual has next best option  $(\tilde{\theta}, \tilde{\phi})$ . It is straightforward to show that the total surplus of the match is independent of the wage, or

$$\begin{aligned} \frac{\partial T_\xi(w, d; \theta, \phi)}{\partial w} &= 0 \text{ for all } (w, d; \theta, \phi, \xi) \\ \Rightarrow T_\xi(w, d; \theta, \phi) &\equiv \tilde{Q}_\xi(d; \theta, \phi). \end{aligned}$$

Therefore, we can redefine the Nash bargaining objective function as a function of the health insurance status and the share of the total surplus of the match earned by the worker,  $\beta$ . We then choose  $d$  and  $\beta$  to maximize the Nash bargaining objective function

$$\tilde{\Xi}_\xi(\beta, d; \theta', \phi', \theta, \phi) = [\beta \tilde{Q}_\xi(d; \theta', \phi') - Q_\xi(\theta, \phi)]^\alpha [(1 - \beta) \tilde{Q}_\xi(d; \theta', \phi')]^{1-\alpha}. \quad (64)$$

Conditional on health insurance status  $d$ , the equilibrium share of the total surplus received by the employee satisfies the first order condition

$$\begin{aligned} \frac{\alpha \tilde{Q}_\xi(d; \theta', \phi')}{[\beta^* \tilde{Q}_\xi(d; \theta', \phi') - Q_\xi(\theta, \phi)]} &= \frac{(1 - \alpha) \tilde{Q}_\xi(d; \theta', \phi')}{(1 - \beta^*) \tilde{Q}_\xi(d; \theta', \phi')} \\ \Rightarrow \alpha(1 - \beta^*) \tilde{Q}_\xi(d; \theta', \phi') &= (1 - \alpha) [\beta^* \tilde{Q}_\xi(d; \theta', \phi') - Q_\xi(\theta, \phi)] \\ \Rightarrow \beta^* \tilde{Q}_\xi(d; \theta', \phi') &= \alpha \tilde{Q}_\xi(d; \theta', \phi') + (1 - \alpha) Q_\xi(\theta, \phi). \end{aligned}$$

Therefore, the conditional on health insurance status  $d$ , the equilibrium value to the worker is given by

$$\hat{V}_\xi^E(d; \theta', \phi', \theta, \phi) = \alpha \tilde{Q}_\xi(d; \theta', \phi') + (1 - \alpha) Q_\xi(\theta, \phi) \quad (65)$$

which implies that

$$\hat{V}_\xi^F(d; \theta', \phi', \theta, \phi) = (1 - \alpha) (\tilde{Q}_\xi(d; \theta', \phi') - Q_\xi(\theta, \phi)). \quad (66)$$

The conditional total surplus is given by

$$\hat{T}_\xi(d; \theta', \phi', \theta, \phi) = \hat{V}_\xi^E(d; \theta', \phi', \theta, \phi) + \hat{V}_\xi^F(d; \theta', \phi', \theta, \phi) = \tilde{Q}_\xi(d; \theta', \phi'). \quad (67)$$

Therefore, in equilibrium, the total surplus of the current match  $(\theta', \phi')$  is independent of the characteristics of the worker's next best option  $(\theta, \phi)$  and hence, the health insurance decision only depends on the “winning” firm's characteristics. ■

## B Proof of Proposition 2

**Proof:** Define the total surplus of the match conditional on health insurance status  $d$  as

$$\begin{aligned} \tilde{Q}_\xi(d; \theta, \phi) &= [\rho + \eta_d + \lambda_e \int_{\Phi} \tilde{G}(\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi})) dF(\tilde{\phi})]^{-1} \\ &\times \{ \theta - (\phi - \xi) d + \eta_d V_\xi^N \\ &+ \lambda_e \int_{\Phi} \int_{\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, d, \theta, \phi) dG(\tilde{\theta}) dF(\tilde{\phi}) \}. \end{aligned} \quad (68)$$

where the critical match  $\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi})$  is implicitly defined by the equation

$$Q_\xi(\tilde{\theta}_\xi(d; \theta, \phi, \tilde{\phi}), \tilde{\phi}) = \tilde{Q}_\xi(d; \theta, \phi)$$

and  $\hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, d, \theta, \phi)$  represents the value to the employee at the match  $(\tilde{\theta}, \tilde{\phi})$  when his threat point is given by  $\tilde{Q}_\xi(d; \theta, \phi)$ . Given proposition 1, we can rewrite the total surplus as

$$\begin{aligned} \tilde{Q}_\xi(d; \theta, \phi) &= [\rho + \eta_d + \alpha\lambda_e \int_{\Phi} \tilde{G}(\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi}))dF(\tilde{\phi})]^{-1} \\ &\quad \times \{\theta - (\phi - \xi)d + \eta_d V_\xi^N \\ &\quad + \alpha\lambda_e \int_{\Phi} \int_{\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi})} Q_\xi(\tilde{\theta}, \tilde{\phi})dG(\tilde{\theta})dF(\tilde{\phi})\}. \end{aligned} \quad (69)$$

Using the definition of the critical match  $\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi})$  we can show that

$$\frac{\partial \tilde{Q}_\xi(d; \theta, \phi)}{\partial \theta} = [\rho + \eta_d + \alpha\lambda_e \int_{\Phi} \tilde{G}(\tilde{\theta}_\xi(d, \theta, \phi, \tilde{\phi}))dF(\tilde{\phi})]^{-1} > 0 \text{ for all } (d, \theta, \phi, \xi). \quad (70)$$

Since  $\tilde{Q}_\xi(d; \theta, \phi)$  is strictly increasing in  $\theta$  for all  $(d, \theta, \phi, \xi)$  we can characterize the decision to initiate an employment contract with health insurance status  $d$  between a type  $\xi$  worker and a type  $\phi$  firm by unique critical match  $\hat{\theta}_\xi^*(d, \phi)$  that satisfies the implicit equation

$$\tilde{Q}_\xi(d; \hat{\theta}_\xi^*(d, \phi), \phi) = V_\xi^N. \quad (71)$$

More explicitly, we can show that

$$\hat{\theta}_\xi^*(d, \phi) = (\phi - \xi)d + \rho V_\xi^N - \alpha\lambda_e \int_{\Phi} \int_{\tilde{\theta}_\xi^*(d, \phi)} [Q_\xi(\tilde{\theta}, \tilde{\phi}) - V_\xi^N]dG(\tilde{\theta})dF(\tilde{\phi}) \quad (72)$$

which implies that the critical match does not depend on the type of firm  $\phi$  when health insurance is not provided and that  $\phi - \xi > 0$  is a necessary condition for the existence of jobs without health insurance at the worker-firm pair  $(\xi, \phi)$ . The intuition behind this condition should be clear. When the private demand  $\xi$  is greater than the cost  $\phi$ , health insurance is effectively free and given that it has beneficial effects on the value of any match will always be purchased.

Assume that every  $(\xi, \phi)$  pair accepts some employment contracts without health insurance so that  $\theta_\xi^* \equiv \hat{\theta}_\xi^*(0, \phi) < \hat{\theta}_\xi^*(1, \phi)$ . It is certainly the case that any match  $\theta \in [\theta_\xi^*, \hat{\theta}_\xi^*(1, \phi)]$  will not result in the provision of health insurance. In addition, since  $\eta_0 > \eta_1$  and  $\int_{\Phi} \tilde{G}(\tilde{\theta}_\xi(0, \theta_\xi^*, \phi, \tilde{\phi}))dF(\tilde{\phi}) = \int_{\Phi} \tilde{G}(\tilde{\theta}_\xi(1, \theta_\xi^*(1, \phi), \phi, \tilde{\phi}))dF(\tilde{\phi})$ , it is clear that  $\tilde{Q}_\xi(1; \theta, \phi)$  increases at a faster rate than  $\tilde{Q}_\xi(0; \theta, \phi)$  for all  $\theta \geq \hat{\theta}_\xi^*(1, \phi)$ . Therefore, there exists a unique critical match  $\theta_\xi^{**}(\phi) > \theta_\xi^*$  such that

$$\tilde{Q}_\xi(0; \theta_\xi^{**}(\phi), \phi) = \tilde{Q}_\xi(1; \theta_\xi^{**}(\phi), \phi). \quad (73)$$

■

## C Approximation of Decision Rules

In this appendix we present our strategy for deriving the equilibrium of the Nash bargaining model. We will consider the most general specification with both worker and firm heterogeneity. The computational burden of solving the model is quite substantial and since estimation of the model requires knowledge of the conditional (on health insurance status  $d$ ) equilibrium wage functions,  $\hat{w}_\xi(d; \theta', \phi', \theta, \phi)$ , and the critical matches for acceptance of an employment contract and the provision of health insurance,  $\theta_\xi^*$  and  $\theta_\xi^{**}(\phi)$ , we are forced to approximate the system of value functions.

After doing so we are able to efficiently solve for the equilibrium of the model without an excessive computational burden.

To begin, recall the value of an employment contract  $(w, d)$  at a match with characteristics  $(\theta, \phi)$  to a worker of type  $\xi$  is given by

$$\begin{aligned}
V_\xi^E(w, d; \theta, \phi) &= [\rho + \eta_d + \lambda_e \int_{\Phi} \tilde{G}(\hat{\theta}_\xi(w, d, \tilde{\phi})) dF(\tilde{\phi})]^{-1} \\
&\times \{w + \xi d + \eta_d V_\xi^N \\
&+ \lambda_e \int_{\Phi} \int_{\hat{\theta}_\xi(w, d, \tilde{\phi})}^{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\theta, \phi, \tilde{\theta}, \tilde{\phi}) dG(\tilde{\theta}) dF(\tilde{\phi}) \\
&+ \lambda_e \int_{\Phi} \int_{\bar{\theta}_\xi(\theta, \phi, \tilde{\phi})} \hat{V}_\xi^E(\tilde{\theta}, \tilde{\phi}, \theta, \phi) dG(\tilde{\theta}) dF(\tilde{\phi})\}.
\end{aligned} \tag{74}$$

and that the critical matches are implicitly defined by the equations

$$\begin{aligned}
V_\xi^F(w, d; \hat{\theta}_\xi(w, d, \tilde{\phi}), \tilde{\phi}) &= 0 \\
Q_\xi(\bar{\theta}_\xi(\theta, \phi, \tilde{\phi}), \tilde{\phi}) &= Q_\xi(\theta, \phi).
\end{aligned} \tag{75}$$

Next, note that the maximum value of  $\theta$  for which the contract  $(w, d)$  would leave a  $\phi$ -type firm with no profit equals  $\hat{\theta}_\xi(w, d, \phi) = w + d\phi$  and the equilibrium wage associated with the worker receiving all the rents from  $\theta$  is  $\hat{w}_\xi(\theta, \phi, \theta, \phi) = \theta - d\phi$ . Given these two implications of the model we then know that

$$V_\xi^E(w = \theta - d\phi, d; \theta, \phi) = Q_\xi(d; \theta, \phi). \tag{76}$$

Taking the first order Taylor series approximation to  $V_\xi^E$  with respect to  $w$  (around  $w = \theta - d\phi$ ), we have

$$V_\xi^E(w, d; \theta, \phi) \approx Q_\xi(d; \theta, \phi) + (w - \theta + d\phi) \left. \frac{\partial V_\xi^E(w, d; \theta, \phi)}{\partial w} \right|_{w=\theta-d\phi} \tag{77}$$

Using Leibniz's rule, the derivative evaluated at  $w = \theta - d\phi$  can be shown to equal

$$\begin{aligned}
\left. \frac{\partial V_\xi^E(w, d; \theta, \phi)}{\partial w} \right|_{w=\theta-d\phi} &= \frac{1}{\rho + \eta_d + \lambda_e \sum_{i=1}^2 p(\phi_i) \tilde{G}(\bar{\theta}_\xi(\theta, \phi, \phi_i))} \\
&\equiv \frac{1}{\beta_\xi(d; \theta, \phi)}.
\end{aligned} \tag{78}$$

Therefore,

$$V_\xi^E(w, d; \theta, \phi) \approx Q_\xi(d; \theta, \phi) + \frac{w - \theta + d\phi}{\beta_\xi(d; \theta, \phi)}. \tag{79}$$

Using the fact that

$$V_\xi^E(\hat{w}_\xi(d; \theta', \phi', \theta, \phi), d; \theta', \phi') = \hat{V}_\xi^E(d; \theta', \phi', \theta, \phi) = \alpha Q_\xi(d; \theta', \phi') + (1 - \alpha) Q_\xi(\theta, \phi)$$

it follows that equilibrium wages, conditional on health insurance  $d$ , are given by the equation

$$\hat{w}_\xi(d; \theta', \phi', \theta, \phi) = \theta' - d\phi' - (1 - \alpha) \beta_\xi(d; \theta', \phi') (Q_\xi(d; \theta', \phi') - Q_\xi(\theta, \phi)). \tag{80}$$

Given the close relationship between the equilibrium outcome (both wages and the provision of health insurance) and the function  $Q_\xi(d; \theta, \phi)$ , the computation of the equilibrium follows a rather

simple three-stage process. First, we solve the fixed point equations for  $Q_\xi(d; \theta, \phi)$  and  $V_\xi^N$  for all  $d, \theta, \phi, \xi$ . Given these values, we determine the critical matches for the acceptance of an employment contract and the provision of health insurance according to the system of equations

$$\begin{aligned} Q_\xi(0, \theta_\xi^*, \phi_1) &= Q_\xi(0, \theta_\xi^*, \phi_2) = V_\xi^N \\ Q_\xi(1, \theta_\xi^{**}(\phi), \phi) &= Q_\xi(0, \theta_\xi^{**}(\phi), \phi) \end{aligned} \tag{81}$$

for  $\xi \in \{\xi_1, \xi_2\}$  and  $\phi \in \{\phi_1, \phi_2\}$ . Finally, we compute the equilibrium wages according to equation [80] above.

## References

- [1] Anderson, Patricia (1997). "The Effect of Employer-Provided Health Insurance on Job Mobility: Job-Lock or Job-Push?" Unpublished manuscript, Dartmouth College.
- [2] Buchmueller, Thomas and Robert Valletta (1996). "The Effects of Employer-Provided Health Insurance on Worker Mobility." *Industrial and Labor Relations Review*, 49, 439-455.
- [3] Cahuc, Pierre, Fabien Postel-Vinay, and Jean-Marc Robin (2003). "Wage Bargaining with On-the-Job-Search: A Structural Econometric Model." Mimeo, University of Paris-I.
- [4] Cooper, Philip and Alan Monheit (1993). "Does Employment-Related Health Insurance Inhibit Job Mobility?" *Inquiry*, 30, 400-416.
- [5] Diamond, Peter (1982). "Wage Determination and Efficiency in Search Equilibrium." *Review of Economic Studies*, 49, 217-227.
- [6] Eberts, Randall and Joe Stone (1985). "Wages, Fringe Benefits, and Working Conditions: An Analysis of Compensating Differentials." *Southern Economic Journal*, 52, 274-280.
- [7] Eckstein, Zvi, and Kenneth Wolpin (1995). "Duration to First Job and the Return to Schooling: Estimates from a Search-Matching Model." *Review of Economic Studies*, 62, 263-286.
- [8] Flinn, Christopher (1986). "Wages and Job Mobility of Young Workers." *Journal of Political Economy*, 94, S88-S110.
- [9] Flinn, Christopher (2002). "Labor Market Structure and Inequality: A Comparison of Italy and the U.S." *Review of Economic Studies* 69, 611-646.
- [10] Flinn, Christopher (2003). "Minimum Wage Effects on Labor Market Outcomes under Search with Bargaining." Mimeo, New York University.
- [11] Flinn, Christopher and James Heckman (1982). "New Methods for Analyzing Structural Models of Labor Market Dynamics." *Journal of Econometrics* 18, 115-168.
- [12] Gilleskie, Donna and Byron Lutz (2002). "The Impact of Employer-Provided Health Insurance on Dynamic Employment Transitions." *Journal of Human Resources* 37, 129-162.
- [13] Gruber, Jonathan (1994). "The Incidence of Mandated Maternity Benefits." *American Economic Review*, 84, 622-641.

- [14] Gruber, Jonathan and Maria Hanratty (1995). "The Labor-Market Effects of Introducing National Health Insurance: Evidence from Canada." *Journal of Business and Economic Statistics*, 13, 163-173.
- [15] Gruber, Jonathan and Alan Krueger (1990). "The Incidence of Mandated Employer-Provided Insurance: Lessons from Workers' Compensation Insurance." Princeton Industrial Relations Section Working Paper #279.
- [16] Gruber, Jonathan and Brigitte Madrian (1997). "Employment Separation and Health Insurance Coverage." *Journal of Public Economics*, 66, 349-382.
- [17] Gruber, Jonathan and Brigitte Madrian (1994). "Health Insurance and Job Mobility: The Effects of Public Policy on Job-Lock." *Industrial and Labor Relations Review*, 48, 86-102.
- [18] Holtz-Eakin, Douglas (1994). "Health Insurance Provision and Labor Market Efficiency in the United States and Germany," in Rebecca Blank and Richard Freeman, eds. *Social Protection Versus Economic Flexibility: Is There a Tradeoff?* Chicago: University of Chicago Press.
- [19] Kapur, Kanika (1998). "The Impact of Health on Job Mobility: A Measure of Job Lock." *Industrial and Labor Relations Review*, 51, 282-298.
- [20] Krueger, Alan (1999). "Measuring Labor's Share." *American Economic Review*, 89, 45-51.
- [21] Levy, Helen and David Meltzer (2001). "What Do We Really Know about whether Health Insurance Affects Health?" University of Michigan, Economic Research Initiative on the Uninsured Working Paper 6.
- [22] Madrian, Brigitte (1994). "Employment-Based Health Insurance and Job Mobility: Is There Evidence of Job-Lock?" *Quarterly Journal of Economics*, 109, 27-54.
- [23] Miller, Robert (1984). "Job Matching and Occupational Choice." *Journal of Political Economy*, 92, 1086-1120.
- [24] Miller, Richard (1995). "Estimating Compensating Differentials for Employer-Provided Health Insurance Benefits." University of California, Santa Barbara, Working Papers in Economics.
- [25] Mitchell, Olivia (1982). "Fringe Benefits and Labor Mobility." *Journal of Human Resources*, 17, 286-298.
- [26] Pissarides, Christopher (1985). "Taxes, Subsidies, and Equilibrium Unemployment." *Review of Economic Studies*, 52, 121-134.
- [27] Postel-Vinay, Fabien and Jean-Marc Robin (2000). "Wage Dispersion with Heterogeneous Firm Technologies and Work Abilities: An Equilibrium Job Search Model for Matched Employer-Employee Data." Mimeo, Laboratoire d'Economie Appliquée de l'INRA, Ecole Normale Supérieure, Paris.
- [28] Wolpin, Kenneth (1992). "The Determinants of Black-White Differences in Early Employment Careers: Search, Layoffs, Quits, and Endogenous Wage Growth." *Journal of Political Economy*, 100, 535-560.
- [29] Yashiv, Eran (2003). "Bargaining, the Value of Unemployment, and the Behavior of Aggregate Wages." Mimeo, Tel Aviv University.

**Table 1a. Individual Employment History Characteristics**

Type of History	Number	Marital		Sample Window
		Status	Children	
Full sample	10,121	0.642	0.443	145.17 (75.14)
Without an unemployment spell	7,307	0.675	0.460	143.06 (77.05)
With an unemployment spell	2,814	0.558	0.397	150.64 (69.63)

**Table 1b. Unemployment Spell Characteristics (2,814 observations)**

Type of Transition	Number	Spell		Accepted Wage	Marital	
		Duration	Initial Wage		Status	Children
Right censored	755	17.26 (30.28)	-	-	0.466	0.336
To a job with health insurance	1,044	9.55 (11.18)	-	15.96 (10.30)	0.647	0.440
To a job without health insurance	1,015	12.27 (14.64)	-	11.30 (8.67)	0.529	0.397

**Table 1c. Characteristics of Jobs with Health Insurance (1,044 observations)**

Type of Transition	Number	Spell		Accepted Wage	Marital	
		Duration	Initial Wage		Status	Children
Right censored	715	77.53 (57.31)	16.71 (10.29)	-	0.649	0.446
To unemployment	162	47.58 (34.97)	14.26 (10.62)	-	0.630	0.401
To a job with health insurance	144	48.80 (37.92)	14.89 (10.19)	16.98 (9.56)	0.660	0.472
To a job without health insurance	23	54.04 (48.34)	11.41 (4.78)	16.14 (18.18)	0.609	0.304

**Table 1d. Characteristics of Jobs without Health Insurance (1,015 observations)**

Type of Transition	Number	Spell		Accepted Wage	Marital	
		Duration	Initial Wage		Status	Children
Right censored	478	44.83 (47.32)	11.75 (8.97)	-	0.552	0.379
To unemployment	314	22.14 (22.24)	10.99 (9.01)	-	0.446	0.373
To a job with health insurance	73	29.99 (25.17)	10.74 (7.32)	11.96 (5.76)	0.562	0.384
To a job without health insurance	150	27.97 (27.10)	10.78 (7.48)	12.67 (9.91)	0.613	0.513

**Note:** Based on the 1996 Survey of Income and Program Participation. The sample includes white males aged 25-54 with at least a high school education. See text for further selection criteria. Wages are measured in dollars per hour and durations are reported in weeks. Standard deviations are in parentheses. The sample window measures the length of time (in weeks) an individual responds to the survey.

**Table 2. Simulated Maximum Likelihood Estimates  
(Bootstrapped Standard Errors)**

Parameter	$\alpha = 0.25$		$\alpha = 0.50$	
	(1)	(2)	(1)	(2)
$\lambda_e$	1.044 (0.030)	1.254 (0.037)	1.247 (0.036)	1.322 (0.025)
$\lambda_n$	6.258 (0.142)	7.001 (0.149)	6.219 (0.184)	7.498 (0.250)
$\eta_1$	0.156 (0.003)	0.153 (0.003)	0.157 (0.003)	0.148 (0.003)
$\eta_0$	1.321 (0.042)	1.325 (0.039)	1.450 (0.038)	1.209 (0.048)
$\mu_\theta$	2.737 (0.010)	2.609 (0.007)	2.500 (0.011)	2.410 (0.008)
$\sigma_\theta$	0.454 (0.011)	0.491 (0.005)	0.409 (0.010)	0.423 (0.005)
$\sigma_\varepsilon$	0.551 (0.017)	0.550 (0.016)	0.553 (0.020)	0.554 (0.017)
$\gamma$	0.853 (0.005)	0.865 (0.004)	0.856 (0.004)	0.867 (0.005)
$b$	-1.666 (0.035)	0.423 (0.019)	-1.155 (0.033)	0.268 (0.049)
$\phi_1$	5.825 (0.089)	5.465 (0.060)	3.598 (0.130)	3.487 (0.111)
$\phi_2$	-	6.781 (0.066)	-	4.811 (0.097)
$\pi$	-	0.039 (0.001)	-	0.043 (0.001)
$\xi_2$	-	0.662 (0.010)	-	1.057 (0.121)
$\delta_0$	-	-1.874 (0.024)	-	-1.974 (0.047)
$\delta_1$	-	1.582 (0.052)	-	1.638 (0.103)
$\delta_2$	-	0.532 (0.014)	-	0.588 (0.029)
$\delta$	-	0.379	-	0.374
$\omega$	0.269	0.269	0.270	0.272
$\Gamma_{SS}$	0.808	0.824	0.923	0.930
$\ln L$	-29,393.09	-29,364.45	-29,371.29	-29,322.86

**Note:** The estimates are based on the assumptions that the annual discount rate is 0.08 and the log of the measurement error is distributed normally with mean 0. The model is estimated using the Nelder-Mead simplex algorithm and the standard errors are computed using bootstrap methods with 50 draws of the data. Standard errors are in parentheses. The parameters are defined in the text. Estimates of the rate parameters represent weekly rates multiplied by 100. Specification 1 assumes homogeneous workers and firms and specification 2 allows both firm and worker heterogeneity and considers observable factors that affect the probability an individual is a high demand type.



**Table 3. Estimated Decision Rules and Labor Market Outcomes**

Parameter	$\alpha = 0.25$		$\alpha = 0.50$	
	(1)	(2)	(1)	(2)
<b>Critical match for the acceptance of employment</b>				
Low demand workers, $\xi_1$	8.85	9.01	7.76	8.37
High demand workers, $\xi_2$	-	9.24	-	8.74
<b>Critical Match for the Provision of Health Insurance</b>				
Low demand worker - high cost firm, $(\xi_1, \phi_2)$	17.53	19.38	13.95	17.55
High demand worker - high cost firm, $(\xi_2, \phi_2)$	-	18.60	-	15.91
Low demand worker - low cost firm, $(\xi_1, \phi_1)$	-	17.36	-	15.01
High demand worker - low cost firm, $(\xi_2, \phi_1)$	-	16.57	-	13.36
<b>Probability match is acceptable out of unemployment</b>				
Low demand workers, $\xi_1$	0.89	0.80	0.87	0.75
High demand workers, $\xi_2$	-	0.78	-	0.72
<b>Probability acceptable match results in health insurance out of unemployment</b>				
Low demand worker - high cost firm, $(\xi_1, \phi_2)$	0.44	0.29	0.43	0.19
High demand worker - high cost firm, $(\xi_2, \phi_2)$	-	0.33	-	0.28
Low demand worker - low cost firm, $(\xi_1, \phi_1)$	-	0.39	-	0.32
High demand worker - low cost firm, $(\xi_2, \phi_1)$	-	0.44	-	0.47
<b>Mean unemployment duration</b>				
Low demand workers, $\xi_1$	17.96	17.89	18.59	17.79
High demand workers, $\xi_2$	-	18.22	-	18.62
<b>Probability of an unemployment spell over sample window</b>				
Low demand workers, $\xi_1$	0.269	0.273	0.270	0.285
High demand workers, $\xi_2$	-	0.263	-	0.251

**Note:** Based on the parameter estimates presented in Table 2.

**Table 4. Estimated Labor Market Outcomes Directly Following an Unemployment Spell**

Parameter	$\alpha = 0.25$		$\alpha = 0.50$	
	(1)	(2)	(1)	(2)
<b>Proportion of Jobs with Health Insurance</b>				
Low demand workers, $\xi_1$	0.44	0.38	0.43	0.32
High demand workers, $\xi_2$	-	0.43	-	0.46
<b>Wages in Jobs with Health Insurance</b>				
Low demand workers, $\xi_1$	15.36 (11.18)	16.03 (11.54)	15.71 (10.92)	17.03 (11.79)
High demand workers, $\xi_2$	-	15.37 (11.34)	-	15.22 (10.64)
<b>Wages in Jobs without Health Insurance</b>				
Low demand workers, $\xi_1$	10.83 (6.48)	11.09 (6.59)	10.75 (6.51)	11.67 (7.18)
High demand workers, $\xi_2$	-	11.26 (6.68)	-	11.52 (7.02)
<b>Durations of Jobs with Health Insurance</b>				
Low demand workers, $\xi_1$	316.55 (357.98)	325.83 (372.80)	298.17 (347.20)	362.58 (404.02)
High demand workers, $\xi_2$	-	312.20 (357.09)	-	313.97 (360.20)
<b>Durations of Jobs without Health Insurance</b>				
Low demand workers, $\xi_1$	50.47 (50.82)	49.93 (50.33)	45.20 (45.46)	54.43 (55.10)
High demand workers, $\xi_2$	-	49.55 (49.96)	-	53.57 (53.70)

**Note:** Based on the parameter estimates presented in Table 2. Wages are measured in dollars per hour and durations are measured in weeks. Standard deviations are in parentheses. The wage represents the first wage in the first job following an unemployment spell and incorporates the measurement error process.

**Table 5. Estimated Labor Market Outcomes in the Steady State**

Parameter	$\alpha = 0.25$		$\alpha = 0.50$	
	(1)	(2)	(1)	(2)
<b>Unemployment Rate</b>				
Low demand workers, $\xi_1$	0.044	0.045	0.046	0.052
High demand workers, $\xi_2$	-	0.044	-	0.042
<b>Health Insurance Coverage Rate (entire population)</b>				
Low demand workers, $\xi_1$	0.874	0.868	0.878	0.846
High demand workers, $\xi_2$	-	0.877	-	0.882
<b>Health Insurance Coverage Rate (employed population)</b>				
Low demand workers, $\xi_1$	0.914	0.909	0.921	0.893
High demand workers, $\xi_2$	-	0.917	-	0.920
<b>Wages in Jobs with Health Insurance</b>				
Low demand workers, $\xi_1$	20.33	20.50	19.37	18.97
	(15.04)	(15.36)	(13.61)	(13.26)
High demand workers, $\xi_2$	-	20.35	-	18.36
	-	(15.32)	-	(12.98)
<b>Wages in Jobs without Health Insurance</b>				
Low demand workers, $\xi_1$	11.50	11.51	11.08	11.52
	(7.10)	(7.06)	(6.68)	(7.04)
High demand workers, $\xi_2$	-	11.68	-	11.82
	-	(7.12)	-	(7.13)

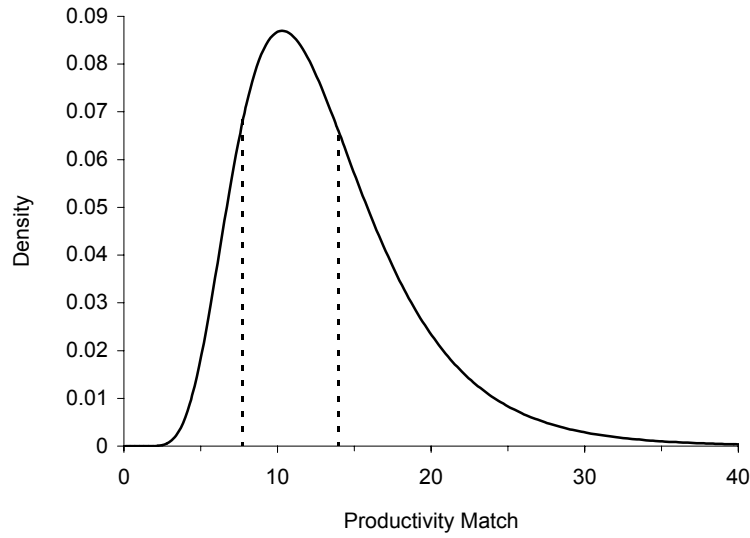
**Note:** Based on the parameter estimates presented in Table 2. The estimates are computed using the simulated labor market histories of 1,000,000 individuals (of each type) who begin their lives in the unemployment state. Wages are measured in dollars per hour and incorporate the measurement error process.

**Table 6. "Inefficiency" Measures**

Parameter	$\alpha = 0.25$	$\alpha = 0.50$
	(2)	(2)
<b>High Demand Types</b>		
Percent of "job-push"	0.48	0.68
Percent of "job-lock"	0.57	0.92
Index of Inefficiency ("job-push" + "job-lock")	1.05	1.60
<b>Low Demand Types</b>		
Percent of "job-push"	0.47	0.65
Percent of "job-lock"	0.56	0.86
Index of Inefficiency ("job-push" + "job-lock")	1.03	1.51
<b>All Workers</b>		
Percent of "job-push"	0.47	0.67
Percent of "job-lock"	0.57	0.89
Index of Inefficiency ("job-push" + "job-lock")	1.04	1.56

**Note:** Based on the parameter estimates presented in Table 2. The estimates are computed using the simulated labor market histories for 1,000,000 individuals (of each type) who begin their working lives in the unemployment state. See text for details and definitions of the measures.

Figure 1. Productivity Density



**Note:** Based on the parameter estimates for the specification with no heterogeneity presented in Column 3 of Table 2. The dotted vertical lines represent the critical matches for transitions out of unemployment and for the provision of health insurance, respectively.

Figure 2a. Conditional Wage Densities

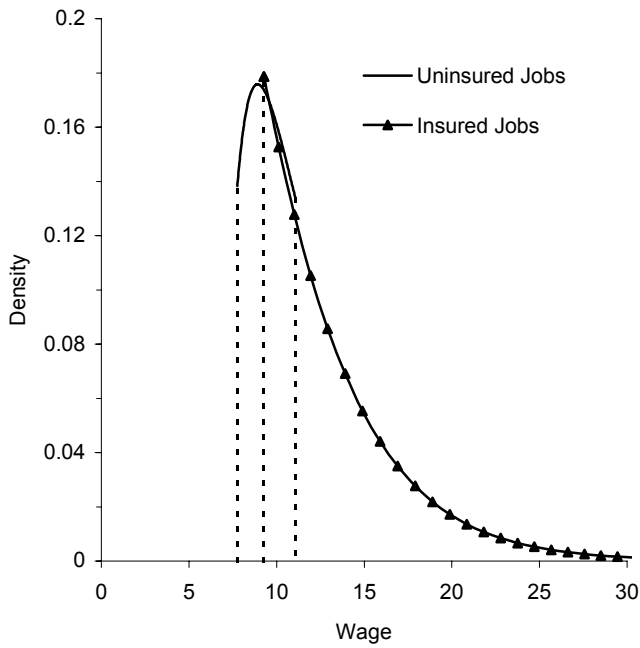
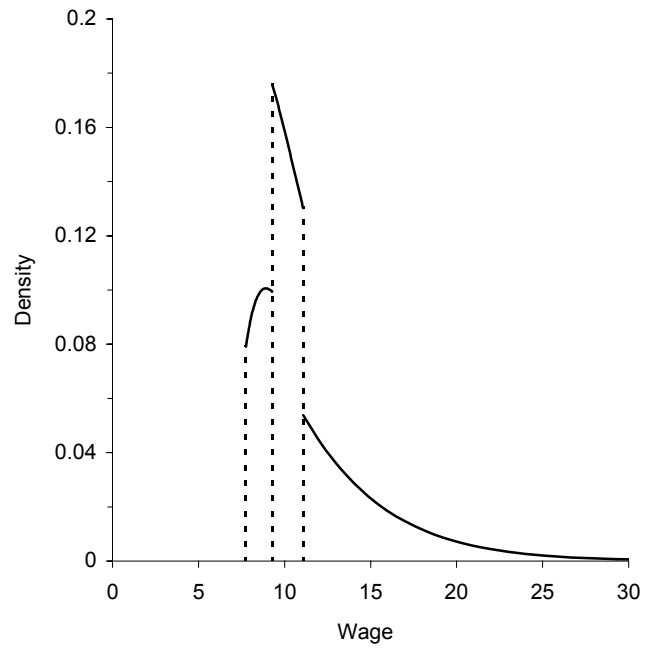


Figure 2b. Unconditional Wage Density



**Note:** Based on the parameter estimates for the specification with no heterogeneity presented in Column 3 of Table 2. Wages represent the first wage reported in the first job directly following an unemployment spell. The dotted vertical lines represent the minimum wage in an uninsured job, the minimum wage in an insured job, and the maximum wage in an uninsured job, respectively. See text for details.

Figure 3a. Steady State Conditional Wage Densities

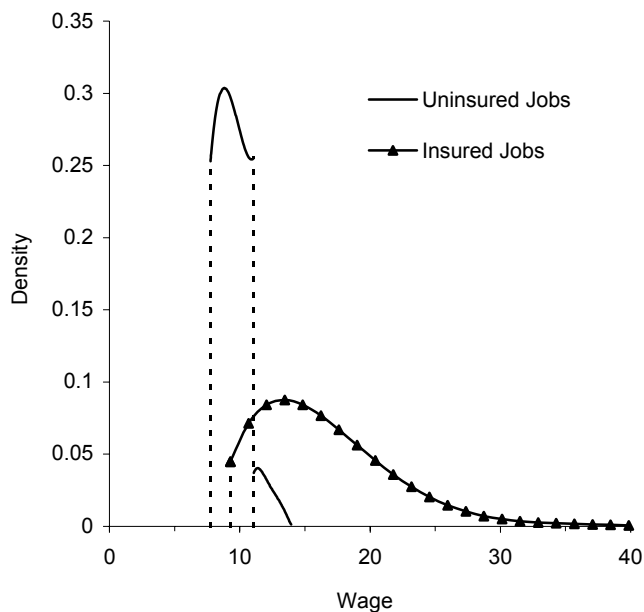
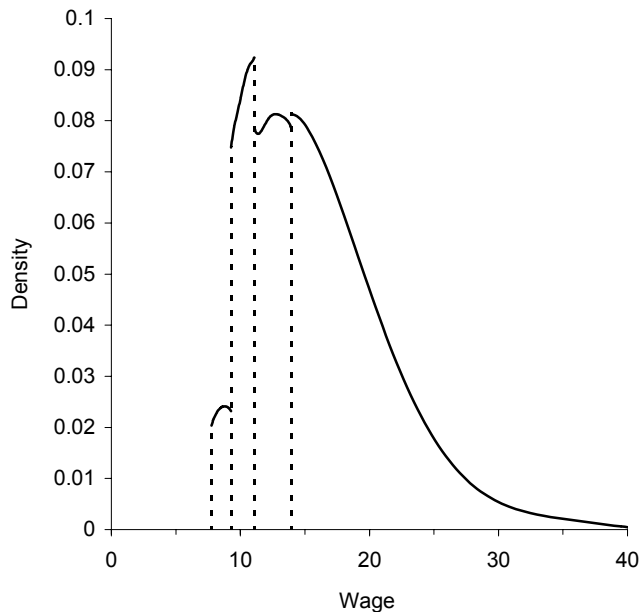
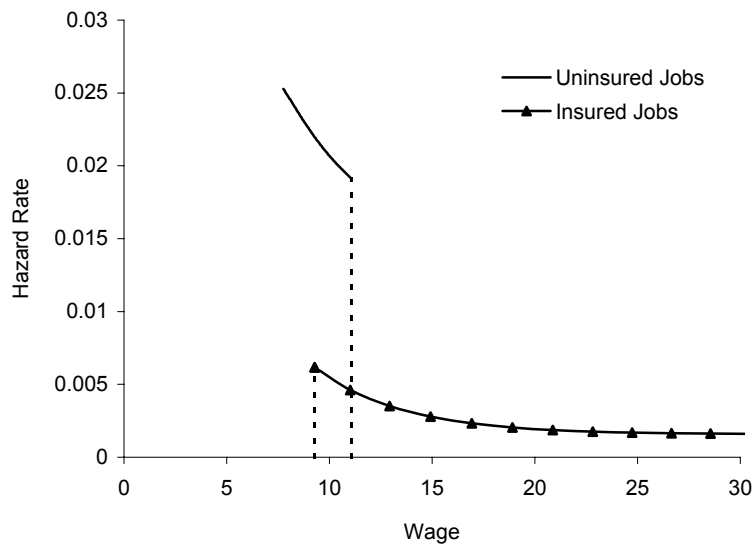


Figure 3b. Steady State Wage Density



**Note:** Based on the parameter estimates for the specification with no heterogeneity presented in Column 3 of Table 2. The distributions are based on the simulated labor market histories of 1,000,000 individuals who begin their working lives in the unemployment state. The dotted vertical lines represent the minimum wage for an uninsured job, the minimum wage for an insured job, the maximum wage for an uninsured job directly following an unemployment spell, and the maximum wage for all uninsured jobs, respectively.

Figure 4. Hazard Rate Comparisons



**Note:** Based on the parameter estimates for the specification with no heterogeneity presented in Column 3 of Table 2. Wages represent the first wage in the first job following an unemployment spell. The hazard rate equals the weekly rate of exiting the current employment state, either through a dismissal to unemployment or a job change. The dotted vertical lines represent the minimum wage for an insured job and the maximum wage for an uninsured job, respectively.

Figure 5a. Actual vs Predicted Wage Densities with Insurance

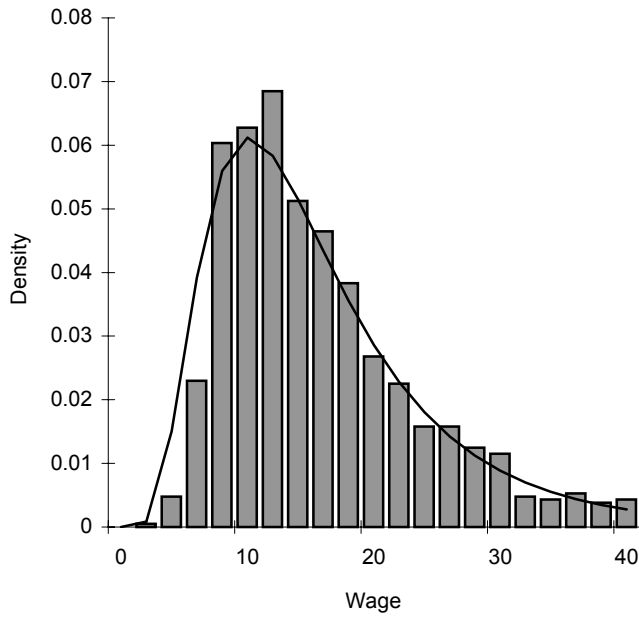
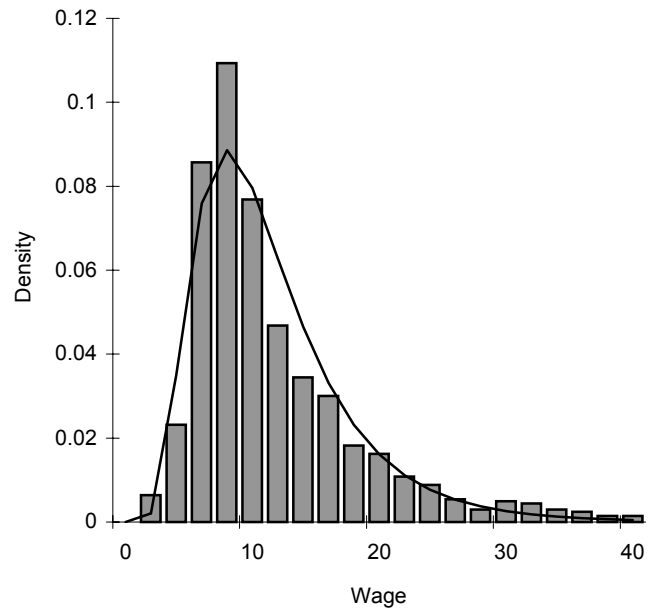


Figure 5b. Actual vs Predicted Wage Densities without Insurance



**Note:** Wages represent the first wage in the first job following an unemployment spell. The predicted wage distribution is based on the parameter estimates for the specification with no heterogeneity presented in Column 3 of Table 2. The actual wage distribution is based on the 1996 panel of the SIPP.

Figure 6a - "Conditional" Job Push

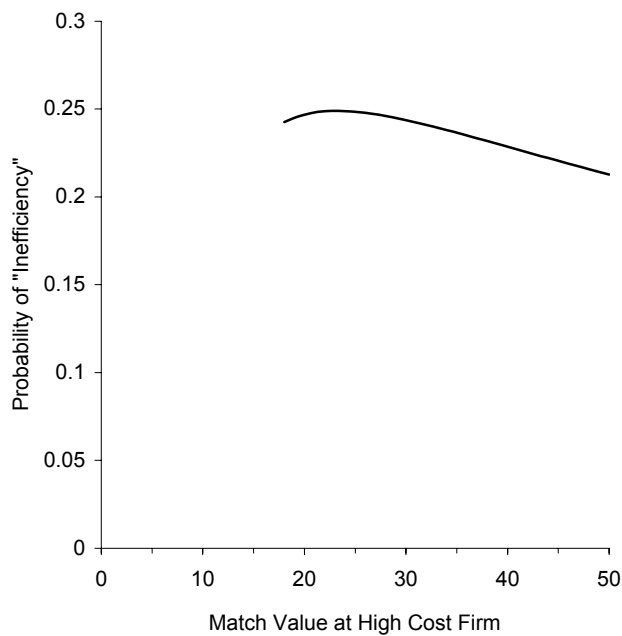
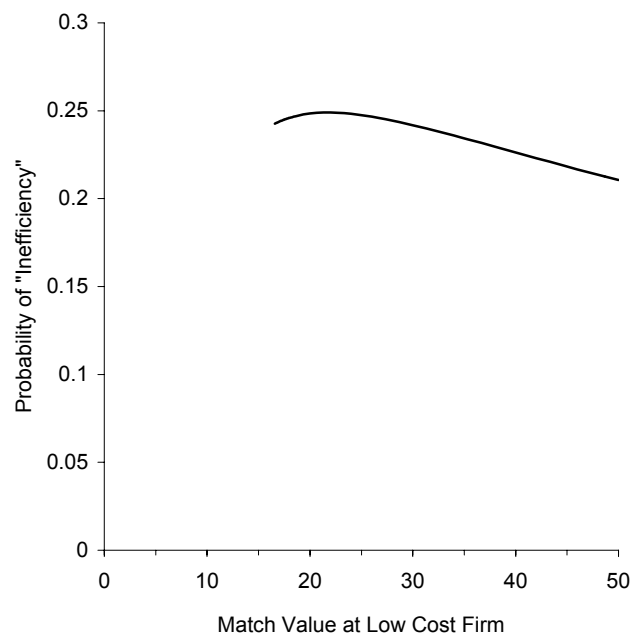


Figure 6b - "Conditional" Job Lock



**Note:** Based on the parameter estimates for the specification with both firm and worker heterogeneity presented in Column 4 of Table 2. The estimates are computed using the simulated labor market histories for 1,000,000 "low demand" individuals who begin their working lives in the unemployment state. See text for details and definitions of the measures.